Naval Research Laboratory
Stennis Space Center, MS 39529-5004

NRL/MR/7240--95-7710

Linear Correlations Between In Situ Fish Spotter Data and Remote Sensing Products Off the West Coast of the United States

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April 1, 1996

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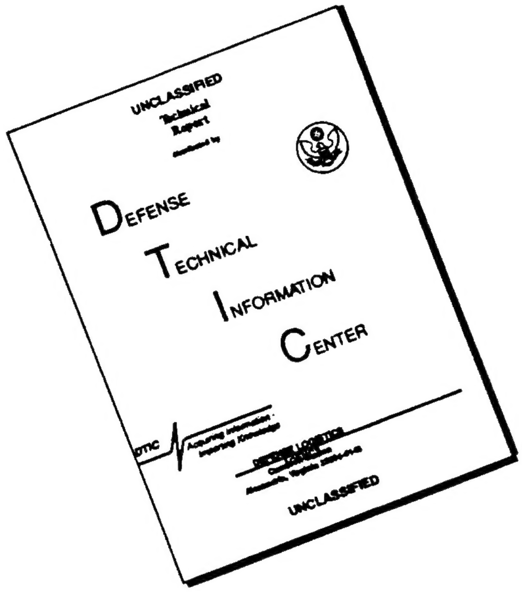

REPORT DOCUMENTATION PAGE

Form Approved
OBM No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
April 1, 1996

3. REPORT TYPE AND DATES COVERED
Final

4. TITLE AND SUBTITLE
Linear Correlations Between In Situ Fish Spotter Data and Remote Sensing Products Off the West Coast of the United States

5. FUNDING NUMBERS
Job Order No. 5710372A4
Program Element No. 0602435N
Project No.
Task No. R035B03
Accession No.

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Research Laboratory
Remote Sensing Division
Stennis Space Center, MS 39529-5004

8. PERFORMING ORGANIZATION REPORT NUMBER
NRL/MR/7240--95-7710

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Office of Naval Research
800 N. Quincy St.
Arlington, VA 22217-5660

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
*Planning Systems Incorporated, 115 Christian Lane, Slidell, LA 70458

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Our understanding between oceanographic properties and the location of fish schools are important to both the fishing industry and to naval oceanography. We explored by using climatological satellite estimates of the ocean properties for estimating fish abundances. Naval interests in fish distribution and abundance creates "false targets" in active sonar systems because of low frequency volume reverberation.

To understand how fish distribution is related to ocean properties, we regressed aerial fish spotter data for tuna, mackerel, sardine, and anchovy (weighted by effort) with hydrographic and remote sensing products (bathymetry, monthly surface chlorophyll, monthly surface temperature, seasonal mixed layer depth, and location of monthly chlorophyll and temperature fronts). Simple and multiple linear regression analyses were performed for each species and each month in 1983 and 1986. Yearly regressions were also performed for the two years. The abundance of tuna, mackerel, sardine, and anchovy showed little or no correlation using the single parameter approach. However, the abundance of all four species are significantly correlated with the six ocean parameters using multiparameter approach for the monthly and yearly regressions for both years. We have developed a software tool to provide a visual aid in the species–specific prediction of areas where fish are most likely to concentrate.

An image database of remote sensing products was created for the West Coast of the United States with a spatial resolution of 20 km. The flight area covered by the aerial fish surveys extended from Half Moon Bay in the north of Cedros Island in the south and offshore as far as Tanner and Cortez Banks. The majority of the flights were concentrated on the region off the southern California coast.

14. SUBJECT TERMS
oceanography, remote sensing, mixed layer depth, climatology

15. NUMBER OF PAGES
129

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	SAR

March 5, 1996

LINEAR CORRELATIONS BETWEEN IN SITU FISH SPOTTER DATA AND REMOTE SENSING PRODUCTS OFF THE WEST COAST OF THE UNITED STATES

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ABSTRACT

Our understanding between oceanographic properties and the location of fish schools are important to both the fishing industry and to Naval oceanography. We explored by using climatological satellite estimates of the ocean properties for esimating fish abundances. Naval interests in fish distribution and abundance arises from the influence of fish bladders on sonar performance. Large fish abundance creates "false targets" in active sonar systems because of low frequency volume reverberation.

To understand how fish distribution is related to ocean properties, we regressed aerial fish spotter data for tuna, mackerel, sardine, and anchovy (weighted by effort) with hydrographic and remote sensing products (bathymetry, monthly surface chlorophyll, monthly surface temperature, seasonal mixed layer depth, and location of monthly chlorophyll and temperature fronts). Simple and multiple linear regression analysis were performed for each species and each month in 1983 and 1986. Yearly regressions were also performed for the two years. The abundance of tuna, mackerel, sardine, and anchovy showed little or no correlation using the single parameter approach. However, the abundance of all four species are significantly correlated with the six ocean parameters using multiparameter approach for the monthly and yearly regressions for both years. We have developed a software tool to provide a visual aid in the species - specific prediction of areas where fish are most likely to concentrate.

An image database of remote sensing products was created for the West Coast of the United States with a spatial resolution of 20 kilometers. The flight area covered by the aerial fish surveys extended from Half Moon Bay in the north to Cedros Island in the south and offshore as far as Tanner and Cortez Banks. The majority of the flights were concentrated on the region off thesouthern California coast.

OBJECTIVE

The objective for this research effort is to attempt to show correlations between remotely sensed ocean parameters with different species of fish and their abundance. These correlations consisted of chlorophyll pigment concentrations, sea surface

temperature, bathymetry, mixed layer depth, chlorophyll and sea surface temperature gradients, with estimated fish abundance and locations obtained from fish spotter aircraft surveys. Parameters used in this study were extracted from the north east Pacific Ocean near the California coast from January through December of 1983 and January through June of 1986. The area and time frame of the research were selected because of available satellite data and fish spotter information. In addition, this type research has a significant importance for Naval tactical oceanography due to low frequency volume reverberation. The fact that many types of fish species and their abundance can be associated with different ocean climatology distributions near the oceans surface played an important role in motivating this research effort.

ACKNOWLEDGEMENTS

The helpful suggestions and support of P. Martinolich, S. Oriol, R. W. Gould, Jr., T. Leming and C. Wood are warmly appreciated. Their contributions are duly noted. Appreciation is extended to R. Love and R. Nero for helpful suggestions and fish spotter data. Appreciation is extended to National Marine Fisheries Service in La Jolla, California for providing spotter data. Appreciation is extended to G. Feldman (Goddard Space Flight Center) for providing Coastal Zone Color Scanner (CZCS) data and the Jet Propulsion Laboratory (JPL) and the University of Miami for providing AVHRR Sea Surface Temperature data. The support of C. Mc Clain and G. Fu is recognized for providing SeaPak software and for helping to establish the databases. Finally, the software development team of Naval Satellite Image Processing System (NSIPS) is acknowledged. This project was supported by the Naval Research Laboratory - Low Frequency Acoustics Program- 6.2 Program Element 62435N, Dr. D. Ramsdale program manager.

LINEAR CORRELATIONS BETWEEN IN SITU FISH SPOTTER DATA AND REMOTE SENSING PRODUCTS OFF THE WEST COAST OF THE UNITED STATES

I. INTRODUCTION

Scientists and researchers are trying to find ways to predict the distribution of fish populations in the oceans of the world. This type of research is very difficult because of the changing environmental conditions, quality of fish data, and lack of understanding of how fish respond and adapt to changing ocean conditions. Satellite imagery provides a unique capability to synoptically characterize the changing ocean environment. As fish distributions are correlated with larger numbers of ocean parameters, the understanding of the correlation and parameters becomes harder to predict. Previous research has demonstrated that fish feed in regions where there are complex interactions between oceanographic processes and fish behavior. The relationships between remotely sensed data and fish abundance and distribution in these areas are more difficult to determine (Arnone; et al; 1992).

Pelagic fish with swim bladders can have a significant impact on the performance of low-frequency acoustic systems. Research shows that fish are scatterers of sound. Swim bladders reflect acoustic energy and produce high levels of volume reverberation in the ocean (Love; 1990). Fish with swim bladders can be detected by sonar and also degrade the sonar's performance (Nero; 1995). Shallow Water Acoustic Models which are used to predict and improve Navy Sonar System performance require inputs of the fish population density.

A major problem in the prediction of fish abundance and location is that fish monitoring programs are limited, fish data are sometimes limited and poor in quality, and the fish data are difficult to obtain. A previous study has shown that fish abundance for whiting in the North Atlantic is poorly correlated with satellite sea surface temperature and surface chlorophyll concentrations (Arnone; et al; 1992). Montgomery et al; (1986) showed that for the California Current System, there was a strong correlation of ocean color and sea surface temperature front locations with fish distribution. Similar correlations were observed in the Gulf of Mexico by Herron et al; 1989. Similarly, Svejkovsky has shown that by using sea surface temperature frontal locations, fish distribution can be predicted (Ostler; 1991). This research has evolved to the point where commercial companies support the fisheries industry by using satellite sea surface temperature imagery.

Remote sensing techniques observe surface conditions and therefore are believed useful for predicting surface schooling locations. It is not known how to reliably extend the remotely sensed surface observations vertically into the water column. Arnone et al; (1992) tried to predict Atlantic whiting using a monthly climatology in the North Atlantic Ocean. Poor correlations were observed between monthly chlorophyll concentrations, sea surface temperature and fish biomass. Arnone et al; (1992) attributed the poor correlations to the following:

(1) Whiting are associated with ocean properties below the ocean surface.

(2) A monthly climatology of an ocean region represents too long of a period to forecast the measurements of fish density.

To improve the use of remote sensing for fish prediction and to improve on the previous research, ocean parameters such as mixed layer depths, bathymetry, surface chlorophyll gradients, and sea surface temperature gradients are considered in this study. In addition, this study will examine different fish species which are better associated with near surface ocean properties.

This research effort differs from the North Atlantic whiting research and other research efforts in that different species of fish are considered, surface related ocean properties are used, and the fish data were collected by airplane (spotter) pilots instead of fishing trawls. Improved correlations are expected from this research effort due to the following:

(1) The fish spotted were near the surface and should show a correlation with surface temperature and chlorophyll as measured from remote sensing .

(2) Fish distributions that are associated with subsurface properties should have improved correlation with bathymetry and mixed layer depth.

(3) Fish distributions that are associated with ocean fronts should have improved correlation with chlorophyll and temperature gradients.

The study uses monthly climatologies of an ocean region and this long time period may play a role in potential poor correlations. Monthly climatologies were used due to coincident satelite data and fish spotter information. This study was conducted in the northeast Pacific Ocean near the southern California coast during January through December of 1983 and January through June of 1986. The area and time frame was also selected because of the available coincident satellite data and fish spotter information. In addition, this research has a significant importance for Naval tactical oceanography due to low frequency volume reverberation. The fact that many types of fish species and their abundance may be associated with different ocean climatology near the oceans surface played an important role in motivating this research effort.

II. DATABASES: IMAGE / CLIMATOLOGY

A low spatial resolution database (20 km) of environmental ocean properties (Arnone et al; 1995; Arnone et al; 1992) was created for the West Coast of the United States which consists of 512 by 512 pixel flat image files by 8 bit grey shade values. The database extends from 10.283 N to 55.283 N and from 101.55 W to 146.55 W representing a degree per pixel ratio of 0.0878906. All the image files exhibit 8-bit grey scale values. The image files are in PC-Seapak file format and contain a 512 - byte header record (Firestone et al; 1989; Arnone et al; 1993). The database resides on a UNIX workstation at the Naval Research Laboratory (NRL), Remote Sensing Applications Branch occupying approximately 312 files totaling 82 megabytes of disk storage. The data types of the 20 km image files are monthly chlorophyll pigment concentration, monthly sea surface temperature, pigment gradient field, SST gradient field, bathymetry and seasonal mixed layer depth.

The chlorophyll pigment concentration database was produced from the Coastal Zone Color Scanner (CZCS) which operated from 1978 to 1986. The data were processed using the Gordon et al; (1983) single scattering algorithm (Feldman et al; 1989). Daily low resolution data were averaged into 20 km regions to produce a monthly average of the chlorophyll pigment distribution (Feldman et al; 1989). A 512 x 512 image was subsectioned from the global product off the United States West Coast (Arnone et al; 1992).

The sea surface temperature database was processed using NOAA - Advanced Very High Resolution Radiometer (AVHRR) infrared data. The database was created from the NODS (NASA Ocean Data System) archives using University of Miami/RSMAS gridded, weekly, interpolated multichannel SST global fields. The NODS database at NRL covers the time frame from October 1981 to December 1988. The database covers a SST range of 0.12 to 31.00 degrees Celsius on a global scale.

Surface horizontal gradient files were created for the 20 km database for sea surface temperature and chlorophyll for each year and for each month. The gradient files show the spatial variability in the temperature and chlorophyll from adjacent pixels in an image and represent climatology of the temperature and chlorophyll surface ocean fronts.

A bathymetry file was created for the low resolution database. These bathymetry files were created from the Synthetic Bathymetric Profiling System (SYNBAPS) data using the PC-Seapak software (Firestone et al; 1989).

Seasonal Mixed Layer Depth files were created for Winter, Summer, Spring, and Autumn. These files were derived from the Generalized Digital Environmental Model (GDEM) seasonal database assuming that the Mixed Layer Depth (MLD) is defined as the depth above the depth where the temperature at depth differs from the surface temperature by more than 0.05 degrees Celsius. The MLD images were created by extending the SST through the mixed layer and combined with the GDEM data at depth (Arnone et al; 1995).

A high spatial resolution database was created using data from the CZCS West Coast Time Series (Abbot et al; 1990). The satellite data are at 1.0 km spatial resolution from CZCS (Coastal Zone Color Scanner, 1978 - 1986) and AVHRR (Advanced Very High Resolution Radiometer) for individual daily scenes covering the eastern Pacific off the West Coast of the United States in "tiles". The Chlorophyll database was created using CZCS data and was processed using the Gordon et al; (1983) single scattering algorithm. The Sea Surface Temperature satellite data was obtained from AVHRR data. A tile is 5.12 degrees latitude by 5.12 degrees longitude. Each tile is a Mercator mapped satellite scene produced at the full resolution of the sensor (1 km) in an 8-bit byte format.

In order to cover all the areas containing fish spotter data, tiles O, S, T, Y, and Z were used (Abbot et al; 1990). These five tiles cover an area from 25 N to 40 N and -115 W to -125 W. The high spatial resolution database at 1 km contains 980 files and takes up 264 megabytes of disk space. The database resides on Primary Oceanographic Predictor Systems (POPS) in a unix tarred and compressed format.

III. AERIAL FISH SPOTTER DATA

The fish spotter data were obtained from the National Marine Fisheries Service (NMFS) / Southwest Fisheries Science Center in La Jolla, California. The pelagic fish aerial monitoring system began in 1962 and has evolved rapidly since that time (Caruso et al; 1983). Commercial fish spotters were contracted to record the location and abundance of fish schools. During 1962, the pilot's recorded their sightings on tape recorders which were later transcribed by the National Marine Fisheries Service. This method allowed for recording and transcription errors. The next year, flight logs were used so that the pilots recorded their own logs. These flight logs contained species type, location, biomass and coast and island outlines. In 1968, a 10 minute square grid was added to the logs. (Caruso et al; 1983)

The spotter data is organized into two file categories, effort and sighting. Effort is a term used for the number of ocean blocks over which a pilot passes. The effort category, therefore, contains the approximate flight path of each pilot for each flight. Sighting is a term which defines an area of boundaries or limits for a group of fish or mammals during the pilot's flight. Both files contain data for 1978 through 1986 and the seven different species types which were listed in the introduction. Biomass for whale (species six) and porpoise (species seven) where not recorded because of their size. The effort file consists of the year, month, day, pilot code, flight number, day(AM)/night(PM) code, latitude, and longitude of flight effort.

The sighting file consists of the year, month, day, pilot code, flight number day(AM)/night(PM) code, latitude and longitude of sighting, species code, and the total tons sighted. Examples of these data files are shown in **Tables A and B**. The years 1983 and 1986 were selected as representative periods to conduct this research. The flights for the spotter pilots were bounded by 28.0 N and 38.0 N (latitude), and -125.0 W and -115.0 W (longitude). **Figure 1** shows the spotter pilot's flight boundaries (Caruso et al; 1983). The pilots flew out of the Santa Barbara, Los Angeles, and San Diego areas. Their flight area consisted of the area bounded by Half Moon Bay in the north, Cedros Island (off of Mexico) in the south and offshore as far as Tanner and Cortez Banks. The majority of the flights were concentrated in Southern California. (Caruso et al; 1983)

The accuracy of the pilot's flight path and sighting varies. The pilots fly all year, day and night, unless there is a problem with the aircraft or the weather does not permit them to fly. The recording accuracy probably increases the closer the observations are to identifiable land marks (Caruso et al; 1983).

For a monthly period, observations were made from the spotter data in the specific region. For example, the total number of cells observed during September 1983 is illustrated in **Figure 2**. There are a total of 195 cells. For each of these grid cells, the type of fish species and approximate tonnage were recorded. It is important to note that for certain cells "no" fish were observed and that a single cell might have been observed more than once. During a single month, approximately twenty flights were conducted. There was between one and three flights per day. These data were

accumulated into a monthly total to represent the monthly statistics. It is recognized that the average monthly statistics are biases because of the limited number of fish spottings throughout the month. The spotter data were combined monthly based on pixel locations and species. For example, if tuna was present in the same pixel for two days then the tonnage was added together for that cell. Due to holidays, weather conditions, aircraft problems, etc., the number of days flown by the pilots varied.

The size, shape, and speed of the fish school are a few of the ways in which the pilots identify fish species. Each pilot has his own techniques. The pilot can only see two dimensions of any school of fish. The density of the school, depth of the school, phosphorescence in the water, water clarity, amount of sunlight and fish dispersion can make it difficult for the pilots to estimate the tonnage (Caruso et al; 1983). The aircraft spotter database contains nine years of data (1978-1986) and seven species of fish. The total number of sightings is 19,385 out of 128,215 flight efforts which occupies approximately six megabytes of disk storage. The seven species types and their codes are:

Species Code #	Name
1	Tuna
2	Mackerel
3	Bill Fish
4	Sardine
5	Anchovy
6	Whale
7	Porpoise

IV. METHODS:

The analysis of the aircraft fish spotter data and the image data bases was divided into seven steps. Fortran, Precision Visuals (PV) Wave, and Interactive Data Language (IDL) software were developed, compiled, and executed on a Silicon graphic computer for this analysis. (PV Wave and IDL represent a commercial advanced programming language for use in image processing and statistical analyses.)

STEP 1: SORTING SPOTTER DATA

Fortran code was written to sort the effort and sighting files. Both files were sorted for a specific year, month, and species type. These (.prn) files obtained from the sorting of the sighting file consists of the year, month, day, latitude, longitude, species code, and total tonnage of the sightings. The (.prn) files obtained from the sorting of the effort file consisted of the year, month, day, latitude, and longitude. The total number of (.prn) files created was 18 months (JAN - DEC 1983, JAN - JUN 1986) x 8 species files is 126 (.prn) files. **Tables C and D** present examples of the sighting and effort (.prn) files.

STEP 2: GRIDDING SPOTTER DATA

Fortran code was written to read in the (.prn) files and create a 60 x 60 block grid. The latitude and longitude spacing for each block to be 1/6 x 1/6 degree area covering the 10 x 10 degree spotter area mentioned in the database section. The data were then placed into a (.out) file which contains the row(i), column(j), total tonnage, total observations, average tons per observation, and the latitude and longitude of the top left corner point of the box. There were also 126 (.out) files created. **Tables E and F** show examples of the sighting and effort (.out) files.

STEP 3: EXTRACTION FROM DATABASE

Fortran code was written to read in six images and the (.out) file for a particular month, year, and species type. The images include bathymetry, sea surface temperature, chlorophyll, mixed layer depth, chlorophyll gradient, and sea surface temperature gradient. The code then reads the latitudes and longitudes from the (.out) file and inputs the grey values from those locations in the image files. If the grey value was zero, which would occur if there were clouds at that cell location in the image, then a 10 x 10 image cell area was averaged to obtain a valid grey value greater than zero. The conversions of image grey values to geophysical values and converting geophysical units back to image grey values are:

Parameter		**Conversion**
	Grey Scale to Geophysical	
Chlorophyll Pigment (CHL) mg/m^3	=	INVLOG(0.012 * GRVAL - 1.4)
Sea Surface Temperature (SST) deg C	=	0.125 * GRVAL
Bathymetry (BAT) m	=	(GRVAL * 23.913) - 22.913
Mixed Layer Depth (MLD) m	=	GRVAL
Gradients (CHL, SST)	=	Same units and conversion as Chlorophyll and SST
	Geophysical to Grey Scale	
Chlorophyll Pigment (CHL) mg/m^3	=	[(LOG(CHL) + 1.4) / 0.12]
Sea Surface Temperature (SST) deg C	=	SST / 0.125
Bathymetry (BAT) m	=	(BAT + 22.913) / 23.913)
Mixed Layer Depth (MLD) m	=	GRVAL
Gradients (CHL, SST)	=	Same units and conversion as Chlorophyll and SST

These values were written to a (.gvl) file. The (.gvl) files contain row(i), column(j), latitude, longitude, total observations, total tonnage, average tons per observation, the six geophysical values, and the image cell / line location. There were also 126 (.gvl) files created. **Tables G and H** are examples of (.gvl) files.

STEP 4: DISPLAY SPOTTER DATA

PV-WAVE code was written to read in the latitudes and longitudes of the (.gvl) files and create an image of the effort / total flight path and sighting locations of each species for 1983 and 1986. Examples are illustrated in the results.

STEP 5: SCATTER PLOTS

PV-WAVE code was written to read in the data files containing the geophysical values. Then code creates postscript xy scatter plots of two specified data types. The plots contain the total effort / flight path and the sightings for a particular year, month, and species. The data types used for the scatter plots were LOG(Chlorophyll) vs. sea surface temperature, LOG(Chlorophyll) vs.Bathymetry, sea surface temperature vs. bathymetry, sea surface temperature vs. mixed layer depth, sea surface temperature vs. chlorophyll gradient, and LOG(chlorophyll) vs. sea surface temperature gradient. Postscript files were created for 1983 and 1986, all 18 months, and all seven species. These plots were created for estimating algorithm parameters for the acoustics model and for the analysis of behavior patterns due to a certain ocean parameter.

STEP 6: DISTRIBUTION OF OCEAN PROPERTIES BY SPECIES - HISTOGRAM -

PV-WAVE code was written to create a postscript file containing eight histogram plots showing the number of observations / count values for a certain data type. One postscript file contains seven species and the total effort plotted for the same month and year. This was done for bathymetry, chlorophyll, sea surface temperature, mixed layer depth, chlorophyll gradient, and sea surface temperature gradient. The postscript files were created for 1983, 1986, and all months.

STEP 7: SINGLE AND MULTIPLE LINEAR REGRESSIONS

IDL code was written to perform single and multiple linear regressions simultaneously while calculating t distribution for the single regressions and the f distribution for the multiple regressions. The independent variables consisted of the six data types and the dependent variable tonnage. The equation follows:

Single:

TONNAGE = A*(DATA TYPE) + B

Multiple:

TONNAGE = (A * BATHYMETRY) + (B * CHLOROPHYLL) + (C * SEA SURFACE TEMPERATURE) + (D * MIXED LAYER DEPTH) + (E * CHLOROPHYLL GRADIENT) + (F * TEMPERATURE GRADIENT) + G

Regressions were run for 1983, 1986, all months, and only four of the seven species. Tuna, Mackerel, Sardine, and Anchovy were used because of sufficient data. Bill fish were omitted because there were no spotter data for the two year period. We were unable to use whale and porpoise because the pilots did not record a tonnage for the two species because of their size. Single and multiple regressions were not obtained if the number of cells observed for a particular month and species was less than seven. The regressions were written to ASCII files and tables were created showing results of the single and multiple regressions.

Note that all cells were normalized by dividing the total tonnage for the cell by the total number of effort for that species and month. For example, there were 600 tons of tuna spotted in a cell and a total effort for that cell of 42. The total tonnage per effort would then be 14.29. This was done so that other cells that were not observed as frequently would not get penalized.

V. RESULTS

Mixed layer depth, bathymetry, remotely sensed chlorophyll, sea surface temperature and gradient databases were reviewed for coincident spotter locations and data for January through December of 1983 and January through June of 1986. **Figures 3-8** show a representation of each satellite parameter for August 1983.

ENVIRONMENTAL DATABASE:

The example of pigment chlorophyll distribution for August 1983 illustrates the high chlorophyll concentration associated with the "squirts and jets" of the California Current System (**Figure 3**). The higher concentration represented by red are observed along the coast. The monthly averaging and larger spatial resolution (20 km) limit our recognition of mesoscale ocean features. The coincident illustration of the sea surface temperature for the monthly composite for August 1983 is shown in **Figure 4**. This example represents climatological conditions during this period. The cooler SSTs of the California Current System are observed along the coast, however the mesoscale features are highly averaged and the depiction is obscured. The database consists of monthly averages throughout the year.

The spatial gradient of the chlorophyll variability was computed by differentiating the chlorophyll concentration image with respect to latitude and longitude (**Figure 5**). Along the coast, higher gradients are observed by the red coloration. This corresponds to a change of concentration of 2 mg / m^3 within a 20 km region. The monthly chlorophyll gradients are quite low in comparison to daily chlorophyll gradients which are observed from high resolution single day chlorophyll images. This suggests that averaging chlorophyll monthly scales and over 20 km areas tends to smooth the true gradients that can be observed crossing a mesoscale ocean front. Notice that the squirts and jet extending offshore are implied by the gradients. The gradient SST illustrates similar patterns in **Figure 6**. The bathymetry of the regions is illustrated in **Figure 7.**

Finally, an example of the summer mixed layer depth is illustrated in **Figure 8**. The spatial resolution of the data is 20 km is reflected in the blocky structure of the figure.

A. AIRCRAFT FISH SPOTTER DATA:

Examples of the aircraft spotter data are illustrated in **Figures 9-12** for Sept. 1983. The sightings of anchovy for this month binned into the locations and biomass are shown in **Figure 9**. The 20 km grid cell observed in the figure identifies the location where anchovy was observed. The light blue color code identifies the approximate biomass (10 tons in this example). Note that anchovy was sighted in approximately 23 grid cells of the possible 195 possible cells (**Figure 2**).

Tuna sightings are illustrated for Sept. 1983 in **Figure 10**. A similar color scheme is used to represent the tonnage. Approximately 67 cells in this month had sightings of tuna which is considerably more than for anchovy.

Mackerel sightings are illustrated for Sept. 1983 in **Figure 11**. The same color

scheme is used to represent the tonnage. Approximately 25 cells in this month had sightings of mackerel which is more than anchovy and less than tuna.

Sardine sightings are illustrated for Sept. 1983 in **Figure 12**. The same color scheme is used to represent the tonnage. Approximately 5 cells in this month had sightings of tuna which is less than tuna, anchovy, and mackerel.

Bill Fish, Porpoise, and Whale where not sighted for this month.

B. SCATTERPLOTS:

The aircraft spotter data were combined with the ocean properties based on location and on a selected month. For each grid cell the biomass for a species was coupled with the corresponding ocean property. The initial results are illustrated in scatter plots. An example is shown for September 1983 for anchovy in which the SST and log of the surface chlorophyll concentration are related to fish observations (**Figure 13**). The 195 cells covering the aircraft total flights are plotted with the corresponding monthly average SST and log (CHL). The SST ranges from 19 to 24 degree C.and the chlorophyll ranged from 0.1 to 3 mg/m^3. The locations where anchovy were spotted is represented as a diamond. Anchovy were observed between 19.5<sst<22.9 and 0.1<chl<2.0 for September.

The depth range of anchovy for September 1983 is related to chlorophyll in **Figure 14**. A high percentage of anchovy appears to be located at depths less than 700 meters. The scattergram of SST and depth is shown in **Figure 15** for September 1983. During the summer months there is no mixed layer depth in this area.

The frontal gradients of SST and chlorophyll are illustrated in the scatterplots for anchovy in September 1983 (**Figures 16,17**). The chlorophyll gradient which is related to SST (**Figure 16**), shows that anchovy are observed over the wide range of chlorophyll gradients (0 to 0.7 mg/m^3). This suggests that the monthly average of the chlorophyll tends to seclude the gradient or front analyses. A similar result is observed in the SST gradient (**Figure 17**) where anchovy are observed at gradients from 0.1 to 0.5 degree C.

C. HISTOGRAMS:

Histograms of the ocean parameters (Chl, SST, depth, GradChl, and Grad SST) for each species (except bill fish and whale) are illustrated for September 1983 (**Figures 18-22**). The mixed layer depth was 0 meters in September and is not shown. This analysis shows how the ocean property is distributed with the observation and begins to define the range which the species prefer. The total number of observations for this month is labeled on the x axis. The y axis represents the ocean property (depth, Chlorophyll, etc).The y scale is the percentage of the total number of observations. The label YMAX on the y axis represents the # of observations for the maximum percentage. The label for the x axis indicates the total number of observations for the month, the monthly mean (MEAN(x)) and the variance (VAR(x)) for this ocean property, and the size of each bin.

Figure 18 shows the range of chlorophyll for each of the 5 species Tuna,

Mackerel, Sardine, Anchovy, and Porpoise for Sept. 1983. The largest percentage of observations occurs in the chlorophyll range of 0.0 - 2.0 mg/m^3. **Figure 19** shows the SST range for the same species of fish. During this month all fish appear to be associated with the 19 -24 degree temperature range. Little difference is observed between the species. **Figure 20** shows the chlorophyll gradient for the 5 species. The observations are not specifically associated with strong chlorophyll gradients as is observed. The majority of the observations appear to be associated with chlorophyll gradient between 0.0 - 1.0 (mg /m^3). **Figure 21** illustrates the SST gradient for the 5 species in Sept. 1983. The ranges for the fish observations occur between 0.0 - 0.1 (degrees Celsius). Finally, **Figure 22** illustrates how the observations for the 5 species are associated with the water depth. Although the observations are spread between 0 - 1600 meters, the majority appear to be associated with the 100 meters depth.

A summary of the other months in 1983 can be found in **Appendix A** (Histograms of Fish Species for Ocean Properties) (**Figures 31 - 97**). Appendix A presents a graphical description of percentages of the observations of each of the species which occur with specified ranges of the environmental parameters for each month of 1983. The results of those histograms are as follows:.

Tuna observations during 1983 peaked off of the coast of Southern California during the months of July, August, and September with the maximum in August. No tuna were spotted during May and June. The tuna were spotted in water of temperatures that ranged from 15 to 24 deg C, with 21 deg C being the most common temperature for the spottings. Chlorophyll values during the period range between 0 and 6 (mg/m^3). Tuna were spotted in waters that ranged from the zero to 2000 meters depth. The mixed layer depth ranged from 0 to 20 (meters) and chlorophyll gradients ranged from 0 to 2 (mg/m^3).

Mackerel observations reached the highest values during April and May . The most common water temperature was 15 deg C in April and 18 deg C during May. Chlorophyll values during this period ranged from 0 to 8 (mg/m^3) and fell between 0 and 5 (mg/m^3) most of the time. The chlorophyll gradient ranged between 0 and 3 mg/m^3. The mixed layer depth was between 0 and 50 (meters) and the mackerel were spotted in waters that varied from 0 to 1600 meters depth, with the highest percentage occurring in waters of 100 meter depth.

The observations for **sardine** indicate that the sardine industry was non-existent in this region for 1983. The most common water temperature were between 15 and 22 deg C. Chlorophyll values ranged from 0 to 6 (mg/m^3) while the chlorophyll gradients were between 0 and 3 (mg/m^3). The most common temperature gradients was between the range 0 and 0.1. The water depth where the sardine was observed ranged from 0 to 600 (meters) while the mixed layer was between 0 and 20 (meters).

Anchovy were spotted in the region from April through September, with the highest number of anchovy observations occurring during April. The sea surface temperature ranged from 15 to 23 deg C. Chlorophyll gradients were low, 0 to 3 mg/m^3, with most values being 0.5. The chlorophyll values ranged from 0 to 3 mg/m^3 during April and May and were zero for the period from June through

September. Mixed layer depth was detected between 0 and 50 (meters) and the anchovy were spotted in waters between 100 and 1400 meters deep.
A summary of these fish rules are illustrated in **Tables I - L**.

TUNA EXAMPLE:

The following results are focused on the example of **tuna** to characterize the analysis performed and the results which will later be applied in the regression analyses. The monthly mean ocean properties for tuna are illustrated in **Figure 26.** The number of observations for tuna are labeled above the corresponding monthly mean indicating that tuna was not observed in April or May during the flight efforts. The time series of Monthly Biomass Observed for Tuna histograms are presented in **Figure 23** for the year 1983. The histogram shows the abundance of tuna during the months of July, August, and September, where greater then 100 observations were made each of these months. August had the greatest observations; 306, totaling 27,003 tons. A minor secondary high occurs in January and February. No tuna were observed in the region during May and June. These data are important in understanding the statistics used in the regressions analyses which will be presented later in that the number of available data limit the possible regression. Notice that the number of observations for each month which are labeled for each month will confine the statistics. For example the July - Sept observations are numerous so that the mean and variance are significant, however in May and April the 2 observations per month restrict the mean and variance values for the range of parameters.

In **Figure 24**, the mean and variance of sea surface temperatures for each month for the tuna distribution are presented. The high levels of tuna biomass observed in August and September (26,000 and 10,000 tons) are associated with the maxima in temperatures greater than 20 degrees C experienced in August and September. The strongest variance in sea surface temperature also occurs during the September maximum. Mean and variance of sea surface temperature gradients are highest during the September to November period as shown in **Figure 25**. However, the largest tuna biomass is observed in July, August and September. The July period represents the time period prior to the changing SST and SST gradient field.

Mean monthly chlorophyll values during 1983 are relatively low (0.05 mg /m^3) during the period of maximum tuna biomass (July - Sept) according to **Figure 26** suggesting that chlorophyll is not a good tracer of tuna. The values of mean chlorophyll concentration during this period are less than one mg/m^3. Higher values of chlorophyll occur during the period from October through February, with the highest mean value exceeding 3 mg/m^3. Mean monthly chlorophyll gradient values are low during the maximum periods of high tuna biomass as shown in **Figure 27**. Peaks in mean monthly chlorophyll gradient occur in October and December with a secondary peak in February. Mean monthly chlorophyll gradient variance is highest in February with other smaller peaks in July, October and November.

Figure 28 presents the monthly mean depths which tuna biomass was observed. The illustration defines where the tuna were accumulated during the year. The highest

tuna biomass observed in July, August and September occurred in areas with depths from 500 to 800 meters depth. A monthly time series of the average mixed layer depth where tuna were observed throughout 1983 is presented in **Figure 29**. Deepest average mixed layer depths occur during the winter months however the total tuna biomass is low during this time period. During the high tuna biomass observed in July, August and September, the average mixed layer depths are zero for the period suggesting a well mixed surface and subsurface layer. During monthly periods where a mixed layer exists, the tuna biomass observed at the surface was minimal. This suggests that surface observations of tuna are linked with the lack of a mixed layer or that the tuna could be observed below the sea surface at the mixed layer depth. However, the limitations of the fish spotter data limits our understanding to only surface biomass.

A summary of the above figures indicates that tuna biomass is highest during the July to September period. Environmental conditions that may be pertinent include high monthly sea surface temperature values and variances, no monthly mean mixed layer depth, a low mean monthly chlorophyll value, and depths between 500 and 800 meters that occur within the cells where the tuna were spotted.

D. REGRESSIONS:

Using the cell locations and fish abundance, the coincident geophysical values for the satellite parameters listed above were obtained for comparison and correlation. A statistical analysis was performed to determine the relationship of the fish biomass and individual ocean properties. Additionally, the statistical relationships were tested on how fish biomass is associated with multiple ocean properties. The statistical relationships were performed for each month in 1983 and 1986 and tabulated in **Tables M - V**.

Yearly and monthly linear regressions were performed for only four (tuna, mackerel, sardine, and anchovy) of the seven species; insufficient data were available during 1983 and 1986 for bill fish , whale and porpoise. Single linear regressions of the biomass and an ocean property were evaluated based on their t distribution. The multiple linear regression of biomass and all 6 ocean properties were evaluated on the correlation coefficient and the significance was determined by using the f distribution. Note that for sea surface temperature gradients and mixed layer depth there were instances where all values were equal. In this case, the ocean property was not used in the correlations. Also, each cell was normalized by dividing the total tonnage for a cell by the number of times(efforts) the pixel was observed. The normalization was done so that other pixels that were not observed as frequently would not be penalized. The significant verifications of the single and multiple regressions were observed from tables in <u>Statistics in Research</u>, by B. Ostle and W. Mensing (1975), 3rd Edition, pp. 544 - 559, using the t and f distributions, and number of cells observed. For the simple regressions, the t distributions, total observations, total effort, total tonnage, and number of cells containing fish for are labeled in **Tables M - T.** For the multiple regressions, the f distributions, total observations, total effort, total tonnage, and the number of pixels containing fish for each parameter (nelem), month, and species in the

regressions for 1983 and 1986 are labeled in **Tables U - V**.

Note: The data were insufficient when there were fewer than seven cell/pixels that contained fish. The regressions were done on a pixel basis. If there was sufficient data to run the regression and there is an x on the chart for mixed layer depth or SST gradients then the values for those parameters were equal and not used in the regressions.

1. SINGLE REGRESSIONS FOR 1983 (Tables M - P)

For **tuna**, there was sufficient data for January, February, July, August and September. No significant correlation between tuna biomass and the six ocean properties was found for January. During the month of February, only mixed layer depth exhibited significant correlation with biomass. In July, bathymetry, chlorophyll and chlorophyll gradient showed significant correlations. In August and September the sea surface temperature property was correlated with tuna biomass.

For **mackerel**, there was sufficient data for January, February, April, May, June, July, August and September. There was not a significant correlation for the six ocean properties for May, June and September. January, February, July and August showed significant correlations between sea surface temperature and mackerel biomass. In April, mackerel biomass had a significant correlation with chlorophyll and July exhibited significant correlation between mackerel biomass and bathymetry.

For **sardine**, there was no sufficient data to determine correlations for 1983.

For **anchovy**, there was sufficient data during April, May, June, July, August and September. No significant correlation between anchovy biomass and the the six ocean properties was found for the other six months.

For **tuna** and **mackerel** there was no significant yearly correlation.

For **sardine** biomass, chlorophyll exhibited a significant yearly correlation and **anchovy** biomass had a significant yearly correlation with sea surface temperature.

2. SINGLE REGRESSIONS FOR 1986 (Tables Q - T)

For **tuna**, the only month with sufficient data was June and a significant correlation with chlorophyll was determined.

For **mackerel**, all months had sufficient data. During March and April no significant correlations were found. In January, mackerel biomass had a significant correlation with chlorophyll gradients. In February and June, mackerel biomass showed significant correlations with sea surface temperature and sea surface temperature gradients, and a significant correlation between mackerel biomass and bathymetry was found in May.

For **sardine**, January, February, April, May and June had sufficient data. The five months exhibited no significant correlation.

For **anchovy**, February, March, April, May and June had sufficient data. March, April, May and June did not have significant correlations. February showed significant correlations between anchovy biomass and chlorophyll gradients

and sea surface temperature gradients.

3. MULTIPLE REGRESSIONS FOR 1983 (Table U, Figures 30 a,b,c)

For **tuna**, the months of January, February, July, August and September contained sufficient data. During the other five months significant correlations between tuna biomass and the six ocean properties were found. The yearly correlation was also significant. Results are shown in **Figure 30a.**

For **mackerel**, January, February, April, May, June, July, August and September contained sufficient data. The correlation for June between mackerel biomass and the six ocean properties showed no significant multiple correlation. During the remaining seven months, multiple correlations were significant. The yearly correlation was also significant. Results are shown in **Figure 30b.**

For **sardine**, there was no sufficient data for each of the twelve months, but the yearly regression was significant.

For **anchovy**, April, May, June, July, August and September had sufficient data. April exhibited no significant correlation. Correlations during the remaining five months were significant. The yearly regression was also significant. Results are shown in **Figure 30c.**

4. MULTIPLE REGRESSIONS FOR 1986 (Table V, Figures 30 e,f,g,h)

For **tuna**, June was the only month that contained sufficient data. June was significantly correlated, as was the yearly correlation. Results are shown in **Figure 30e.**

For **mackerel**, all six months had sufficient data. All correlations are significant including the yearly correlation. Results are shown in **Figure 30f.**

For **sardine**, January, February, April, May and June had insufficient data. All five months had significant correlations, as did the yearly correlation. Results are shown in **Figure 30g.**

For **anchovy**, February, March, April, May and June had sufficient data. Correlations for all five months sampled were significant, as was the yearly correlation. Results are shown in **Figure 30h.**

VI. CONCLUSIONS

The monthly and yearly single correlations for tuna, mackerel, sardine and anchovy for 1983 and 1986 using the single parameter approach does not provide a predictive ability for estimating the distribution of the four fish species. The monthly correlation for 1983 and 1986 for tuna, mackerel, sardine, and anchovy with the six ocean parameters provides a rudimentary predictive ability for estimating the distribution of tuna on a monthly basis. The yearly correlation for 1983 and 1986 for the four species with the six ocean parameters provides a predictive capability for estimating the yearly distribution of tuna.

The results in this study gives a predictive capability for estimating fish biomass for surface related fish species using multiple surface related satellite parameters. A shorter time scale, daily or weekly monthly averages, and higher resolution (e.g. 1 kilometer) satellite imagery should improve correlations. The shorter time scale would be more efficient in studying fish behavior with evolving physical and biological processes. The improved satellite resolution would offer a better understanding of the influence of environmental conditions on the fish distribution. This study was also attempted with 1 kilometer (daily) satellite imagery. The timeliness of the individual satellite images in reference to the daily fish spotter data was too sparse to make a correlation. In addition to the ocean parameters used in this experiment, correlation with solar irradiance and winds would possibly produce better results. The study of real time fish data and satellite imagery could provide improvements to predicting fish distribution and acoustic volume reverberation.

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CAPTIONS

Figure 1. Spotter pilot's flight boundaries. Pixel resolution is 20 km.
Figure 2. An example image of the total number of cells observed for the flight effort during September 1983. The pixel resolution is 20 km.
Figure 3. A database example of the pigment chlorophyll distribution for August 1983.
Figure 4. A database example of Sea Surface Temperature for August 1983.
Figure 5. A database example of the chlorophyll gradient of the for August 1983.
Figure 6. A database example of the Sea Surface Temperature gradient for August 1983.
Figure 7. Bathymetry database of the region.
Figure 8. A database example of seasonal mixed layer depth from August 1983.
Figure 9. Anchovy sighting locations for September 1983.
Figure 10. Tuna sighting locations for September 1983.
Figure 11. Mackerel sighting locations for September 1983.
Figure 12. Sardine sighting locations for September 1983.
Figure 13. A scatter-plot of SST and surface chlorophyll concentrations for anchovy

TABLE A

EFFORT FILE EXAMPLE

YR	MN	DY	PIL	FLT	AMPM	LAT	LNG
78	1	7	9	1	1	33.67	118.33
78	1	7	9	1	1	33.67	118.50
78	1	7	9	1	1	33.50	118.33
78	1	7	9	1	1	33.50	118.50
78	1	7	9	1	1	33.50	118.33
78	1	7	9	1	1	33.33	118.33
78	1	7	9	1	1	33.33	118.17
78	1	7	9	1	1	33.33	118.00
78	1	7	9	1	1	33.33	117.83
78	1	7	9	1	1	33.33	117.67
78	1	7	9	1	1	33.50	117.67
78	1	7	9	1	1	33.50	117.83
78	1	7	9	1	1	33.50	118.00
78	1	7	9	1	1	33.67	118.00
78	1	7	9	1	1	33.67	118.17
78	1	8	2	1	2	33.67	118.33
78	1	8	2	1	2	33.83	118.50
78	1	8	2	1	2	33.83	118.67
78	1	8	2	1	2	33.67	118.67
78	1	8	2	1	2	33.83	118.50
78	1	8	2	1	2	33.67	118.50
78	1	8	2	1	2	33.67	118.33
78	1	8	2	1	2	33.50	118.33
78	1	8	2	1	2	33.33	118.33
78	1	8	2	1	2	33.33	118.17

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TABLE B

SIGHTING FILE EXAMPLE

YR	MN	DY	PIL	FLT	AMPM	LAT	LNG	SPEC	TONNAGE
78	1	7	9	1	1	33.33	118.00	5	25
78	1	7	9	1	1	33.33	118.17	5	25
78	1	8	2	1	2	32.67	118.33	0	0
78	1	8	2	1	2	32.83	118.33	2	20
78	1	8	2	1	2	33.33	119.00	2	40
78	1	8	3	1	2	32.67	118.33	2	2000
78	1	8	3	1	2	33.17	118.33	0	10000
78	1	8	3	1	2	33.33	118.17	2	2000
78	1	8	3	1	2	33.33	118.33	2	3000
78	1	11	2	1	2	33.50	118.00	2	3000
78	1	11	2	1	2	33.83	118.50	2	5000
78	1	11	2	1	2	34.00	119.00	0	0
78	1	11	2	1	2	34.00	119.17	2	1000
78	1	11	7	1	2	32.67	118.33	2	3000
78	1	11	7	1	2	33.17	118.33	0	9000
78	1	12	3	1	2	33.33	118.17	2	5000
78	1	12	3	1	2	33.50	118.17	2	10000
78	1	12	3	1	2	34.00	118.83	0	5000
78	1	15	11	1	2	34.00	119.00	0	350
78	1	15	11	1	2	34.00	119.33	2	200
78	1	15	11	1	2	34.00	119.50	2	50
78	1	16	2	1	2	33.17	118.17	0	0
78	1	17	3	1	2	33.17	118.33	2	2000
78	1	17	3	1	2	33.33	118.33	2	5000
78	1	18	11	1	2	33.83	119.50	2	20

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TABLE C

SIGHTING (.PRN) FILE EXAMPLE - FILENAME IS 8831.prn

(FILENAME - MNYRSP.PRN, MN = MONTH (8), YR = YEAR (83), SP = SPECIES CODE (5))

YR	MN	DY	LAT	LNG	SP	TONS
83	8	3	33.83	118.67	5	100
83	8	4	33.33	118.17	5	10

83	8	5	32.50	117.83	5	8
83	8	5	32.50	118.00	5	15
83	8	5	32.67	118.00	5	8
83	8	6	33.00	117.83	5	300
83	8	6	33.00	118.00	5	200
83	8	6	33.17	117.83	5	2000
83	8	6	33.17	118.00	5	500
83	8	6	33.50	118.00	5	20
83	8	9	33.17	117.67	5	15
83	8	9	33.33	117.67	5	50
83	8	9	33.33	117.83	5	15
83	8	10	33.17	117.33	5	22
83	8	10	33.17	117.50	5	125
83	8	10	33.17	117.67	5	3
83	8	11	33.17	118.00	5	50
83	8	11	33.33	118.00	5	75
83	8	11	34.00	119.17	5	15
83	8	11	34.00	119.17	5	50
83	8	14	33.83	118.50	5	20
83	8	16	32.67	117.83	5	30
83	8	17	33.00	117.50	5	50
83	8	17	33.00	117.67	5	75
83	8	19	32.67	117.67	5	50
83	8	19	32.67	117.83	5	50
83	8	21	33.50	117.67	5	8
83	8	21	33.50	117.83	5	12
83	8	25	33.83	118.50	5	50
83	8	25	33.83	118.67	5	10

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TABLE D
EFFORT (.PRN) FILE EXAMPLE - FILENAME IS 883x.prn
(FILENAME - MNYRSP.PRN, MN = MONTH (8), YR = YEAR (83),
SP = SPECIES CODE (x))

YR	MN	DY	LAT	LNG	SP	TONS
83	8	1	32.67	117.17	X	0
83	8	1	32.67	117.33	X	0
83	8	1	32.50	117.33	X	0
83	8	1	32.33	117.33	X	0
83	8	1	32.17	117.17	X	0
83	8	1	32.00	117.17	X	0
83	8	1	31.83	117.17	X	0
83	8	1	31.83	117.00	X	0
83	8	1	31.67	117.00	X	0
83	8	1	31.67	116.83	X	0
83	8	1	31.50	116.83	X	0
83	8	1	31.33	116.83	X	0
83	8	1	31.33	116.67	X	0
83	8	1	31.17	116.67	X	0
83	8	1	31.00	116.67	X	0
83	8	1	30.83	116.50	X	0
83	8	1	30.67	116.50	X	0
83	8	1	30.50	116.50	X	0
83	8	1	30.33	116.50	X	0
83	8	1	30.33	116.33	X	0
83	8	1	30.17	116.33	X	0
83	8	1	30.00	116.33	X	0
83	8	1	29.83	116.33	X	0
83	8	1	29.83	116.17	X	0
83	8	1	30.00	116.17	X	0
83	8	1	30.17	116.17	X	0
83	8	1	30.33	116.17	X	0
83	8	1	30.33	116.33	X	0

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TABLE E
SIGHTING (.OUT) FILE EXAMPLE - FILENAME IS 8835.out
(FILENAME - MNYRSP.out, MN = MONTH (8), YR = YEAR (83),
SP = SPECIES CODE (5))

I	J	TTON	TOBS	XBAR	LAT1	LNG1
28	43	15	1	15.00	32.50	-118.00
28	44	8	1	8.00	32.50	-117.83
28	47	0	1	0.00	32.50	-117.33
29	43	8	1	8.00	32.67	-118.00
29	44	80	2	40.00	32.67	-117.83
29	45	50	1	50.00	32.67	-117.67
29	46	0	1	0.00	32.67	-117.50
29	47	0	2	0.00	32.67	-117.33
30	45	1000	1	1000.00	32.83	-117.67
30	46	0	1	0.00	32.83	-117.50
30	47	0	1	0.00	32.83	-117.33
31	43	200	1	200.00	33.00	-118.00

31	44	300	1	300.00	33.00	-117.83
31	45	75	1	75.00	33.00	-117.67
31	46	50	1	50.00	33.00	-117.50
32	43	550	2	275.00	33.17	-118.00
32	44	2000	1	2000.00	33.17	-117.83
32	45	18	2	9.00	33.17	-117.67
32	46	305	2	152.00	33.17	-117.50
32	47	22	1	22.00	33.17	-117.33
33	42	10	1	10.00	33.33	-118.17
33	43	75	1	75.00	33.33	-118.00
33	44	15	1	15.00	33.33	-117.83
33	45	50	1	50.00	33.33	-117.67
33	46	20	1	20.00	33.33	-117.50
34	43	20	1	20.00	33.50	-118.00
34	44	12	1	12.00	33.50	-117.83
34	45	8	1	8.00	33.50	-117.67
36	39	110	2	55.00	33.83	-118.67

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TABLE F
EFFORT (.OUT) FILE EXAMPLE - FILENAME IS 883x.out
(FILENAME - MNYRSP.out, MN = MONTH (8), YR = YEAR (83),
SP = SPECIES CODE (x))

I	J	TTON	TOBS	XBAR	LAT1	LNG1
3	59	0	1	0.00	28.33	-115.33
4	57	0	1	0.00	28.50	-115.67
4	58	0	5	0.00	28.50	-115.50
4	59	0	6	0.00	28.50	-115.33
5	57	0	2	0.00	28.67	-115.67
5	58	0	9	0.00	28.67	-115.50
5	59	0	6	0.00	28.67	-115.33
6	57	0	6	0.00	28.83	-115.67
6	58	0	8	0.00	28.83	-115.50
6	59	0	3	0.00	28.83	-115.33
7	57	0	8	0.00	29.00	-115.67
7	58	0	8	0.00	29.00	-115.50
7	59	0	2	0.00	29.00	-115.33
8	55	0	1	0.00	29.17	-116.00
8	56	0	3	0.00	29.17	-115.83
8	57	0	10	0.00	29.17	-115.67
8	58	0	5	0.00	29.17	-115.50
9	54	0	1	0.00	29.33	-116.17
9	55	0	3	0.00	29.33	-116.00
9	56	0	10	0.00	29.33	-115.83
9	57	0	9	0.00	29.33	-115.67
9	58	0	2	0.00	29.33	-115.50
10	54	0	2	0.00	29.50	-116.17
10	55	0	5	0.00	29.50	-116.00
10	56	0	11	0.00	29.50	-115.83
10	57	0	5	0.00	29.50	-115.67
11	54	0	6	0.00	29.67	-116.17
11	55	0	6	0.00	29.67	-116.00
11	56	0	8	0.00	29.67	-115.83

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TABLE G
SIGHTING (.GVL) FILE EXAMPLE - FILENAME IS 8835.gvl
(FILENAME - MNYRSP.gvl, MN = MONTH (8), YR = YEAR (83),
SP = SPECIES CODE (5))

I	J	LAT	LNG	TOBS	TTONS	XBAR	BAT	CHL	SST	MLD	CHLGRAD	SSTGRAD	PIX/LINE
28	43	32.50	-118.00	1	15	15.00	1580.38	0.13	21.50	0.00	0.04	0.25	325/ 260
28	44	32.50	-117.83	1	8	8.00	1197.50	0.12	21.63	0.00	0.04	0.25	327/ 260
28	47	32.50	-117.33	1	0	0.00	336.02	0.51	21.88	0.00	0.34	0.13	333/ 260
29	43	32.67	-118.00	1	8	8.00	623.18	0.13	21.50	0.00	0.04	0.13	325/ 258
29	44	32.67	-117.83	2	80	40.00	623.18	0.13	21.75	0.00	0.05	0.13	327/ 258
29	45	32.67	-117.67	1	50	50.00	958.20	0.14	22.13	0.00	0.12	0.13	329/ 258
29	46	32.67	-117.50	1	0	0.00	766.76	0.16	22.13	0.00	0.23	0.13	331/ 258
29	47	32.67	-117.33	2	0	0.00	168.51	0.35	22.13	0.00	0.32	0.13	333/ 258
30	45	32.83	-117.67	1	1000	1000.00	982.13	0.18	21.88	0.00	0.20	0.13	329/ 256
30	46	32.83	-117.50	1	0	0.00	671.04	0.35	22.13	0.00	0.28	0.13	331/ 256
30	47	32.83	-117.33	1	0	0.00	168.51	0.93	22.00	0.00	0.38	0.13	333/ 256
31	43	33.00	-118.00	1	200	200.00	814.62	0.15	21.75	0.00	0.19	0.13	325/ 254
31	44	33.00	-117.83	1	300	300.00	790.69	0.19	21.75	0.00	0.28	0.13	327/ 254
31	45	33.00	-117.67	1	75	75.00	718.90	0.51	22.00	0.00	0.31	0.13	329/ 254
31	46	33.00	-117.50	1	50	50.00	575.32	1.26	22.13	0.00	0.38	0.13	331/ 254
32	43	33.17	-118.00	2	550	275.00	766.76	0.69	21.75	0.00	0.43	0.13	325/ 252
32	44	33.17	-117.83	1	2000	2000.00	647.11	0.86	22.00	0.00	0.47	0.13	327/ 252
32	45	33.17	-117.67	2	18	9.00	551.39	2.07	22.00	0.00	0.44	0.13	329/ 252
32	46	33.17	-117.50	2	305	152.00	192.44	0.67	21.88	0.00	0.45	0.13	331/ 252
32	47	33.17	-117.33	1	22	22.00	336.02	0.79	22.00	0.00	0.63	0.13	333/ 252
33	42	33.33	-118.17	1	10	10.00	551.39	1.53	21.50	0.00	0.39	0.13	323/ 250

33	43	33.33	-118.00	1	75	75.00	599.25	2.88	21.63	0.00	0.51	0.13	325/ 250
33	44	33.33	-117.83	1	15	15.00	575.32	1.13	21.50	0.00	0.67	0.25	327/ 250
33	45	33.33	-117.67	1	50	50.00	240.30	0.90	22.13	0.00	0.65	0.25	329/ 250
33	46	33.33	-117.50	1	20	20.00	312.09	1.01	21.88	0.00	0.77	0.25	331/ 250
34	43	33.50	-118.00	1	20	20.00	288.16	0.95	22.00	0.00	0.70	0.13	325/ 248
34	44	33.50	-117.83	1	12	12.00	120.65	1.29	22.00	0.00	0.95	0.25	327/ 248
34	45	33.50	-117.67	1	8	8.00	312.09	1.33	21.63	0.00	0.83	0.25	329/ 248
36	39	33.83	-118.67	2	110	55.00	455.67	0.45	21.25	0.00	0.60	0.13	318/ 245
36	40	33.83	-118.50	2	70	35.00	168.51	1.22	21.00	0.00	0.29	0.13	320/ 245
37	36	34.00	-119.17	2	65	32.00	383.88	1.96	20.63	0.00	0.83	0.25	312/ 243

TABLE H

EFFORT (.GVL) FILE EXAMPLE - FILENAME IS 883x.gvl

(FILENAME - MNYRSP.gvl, MN = MONTH (8), YR = YEAR (83),

SP = SPECIES CODE (x))

I	J	LAT	LNG	TOBS	TTONS	XBAR	BAT	CHL	SST	MLD	CHLGRAD	SSTGRAD	PIX/LINE
3	59	28.33	-115.33	1	0	0.00	72.79	0.14	23.00	0.00	0.08	1.13	356/ 307
4	57	28.50	-115.67	1	0	0.00	838.55	0.18	22.38	0.00	0.07	0.25	352/ 305
4	58	28.50	-115.50	5	0	0.00	240.30	0.23	22.63	0.00	0.07	0.13	354/ 305
4	59	28.50	-115.33	6	0	0.00	96.72	0.21	22.88	0.00	0.05	0.13	356/ 305
5	57	28.67	-115.67	2	0	0.00	671.04	0.17	22.38	0.00	0.08	0.25	352/ 303
5	58	28.67	-115.50	9	0	0.00	503.53	0.25	22.50	0.00	0.08	0.13	354/ 303
5	59	28.67	-115.33	6	0	0.00	264.23	0.29	22.63	0.00	0.11	0.13	356/ 303
6	57	28.83	-115.67	6	0	0.00	1436.80	0.19	22.25	0.00	0.08	0.25	352/ 301
6	58	28.83	-115.50	8	0	0.00	862.48	0.27	22.38	0.00	0.08	0.38	354/ 301
6	59	28.83	-115.33	3	0	0.00	336.02	0.31	22.50	0.00	0.22	0.13	356/ 301
7	57	29.00	-115.67	8	0	0.00	1484.66	0.27	22.25	0.00	0.22	0.13	352/ 300
7	58	29.00	-115.50	8	0	0.00	838.55	0.55	22.25	0.00	0.28	0.38	354/ 300
7	59	29.00	-115.33	2	0	0.00	288.16	0.41	22.00	0.00	0.33	0.13	356/ 300
8	55	29.17	-116.00	1	0	0.00	1771.82	0.18	22.00	0.00	0.05	0.13	348/ 298
8	56	29.17	-115.83	3	0	0.00	1628.24	0.41	22.13	0.00	0.08	0.13	350/ 298
8	57	29.17	-115.67	10	0	0.00	1388.94	1.41	22.13	0.00	0.43	0.13	352/ 298
8	58	29.17	-115.50	5	0	0.00	455.67	2.13	22.13	0.00	0.53	0.25	354/ 298
9	54	29.33	-116.17	1	0	0.00	2058.98	0.17	22.00	0.00	0.04	0.13	346/ 296
9	55	29.33	-116.00	3	0	0.00	1915.40	0.27	21.88	0.00	0.09	0.13	348/ 296
9	56	29.33	-115.83	10	0	0.00	1676.10	0.95	21.88	0.00	0.28	0.13	350/ 296
9	57	29.33	-115.67	9	0	0.00	790.69	4.37	22.00	0.00	0.15	0.25	352/ 296
9	58	29.33	-115.50	2	0	0.00	168.51	3.50	21.88	0.00	0.23	0.63	354/ 296
10	54	29.50	-116.17	2	0	0.00	2058.98	0.16	21.88	0.00	0.23	0.13	346/ 294
10	55	29.50	-116.00	5	0	0.00	1915.40	0.23	21.75	0.00	1.01	0.13	348/ 294
10	56	29.50	-115.83	11	0	0.00	1101.78	0.88	21.88	0.00	0.72	0.13	350/ 294
10	57	29.50	-115.67	5	0	0.00	240.30	3.40	21.88	0.00	1.33	0.13	352/ 294
11	54	29.67	-116.17	6	0	0.00	2011.12	0.14	22.13	0.00	0.69	0.13	346/ 292
11	55	29.67	-116.00	6	0	0.00	1676.10	0.13	22.00	0.00	3.40	0.13	348/ 292

Table I. FISH RULES FOR 1983

Tuna	BAT(m)	CHL(mg/m3)	SST(C)	MLD(m)	GC(mg/m3)	GS(C)
JAN	0 - 900	0 - 4	15 - 17	0 - 20	0 - 0.5	0 - 0.1
FEB	100 - 800	0 - 6	15 - 16	0 - 20	0 - 1	0 - 0.1
MAR	600 - 1400	0 - 1	16 - 17	0 - 20	0 - 0.5	0 - 0.1
APR	1300 - 1400	0 - 1	15 - 16	0 - 10	0 - 0.5	0 - 0.1
MAY	x	x	x	x	x	x
JUN	x	x	x	x	x	x
JUL	0 - 1900	0 - 3	17 -20	0	0 - 1	0 - 0.1
AUG	0 - 1900	0 - 3	19 - 23	0	0 - 0.5	0 - 0.1
SEP	0 - 1800	0 - 6	19 - 24	0	0 - 0.5	0 - 0.1
OCT	0 - 200	0 - 5	19 - 20	0 - 10	0 - 2	0 - 0.1
NOV	0 - 200	0 - 4	17 - 18	0 - 10	0 - 2	0 - 0.1
DEC	100 - 200	0 - 3	15 - 16	0 - 10	0 - 0.5	0 - 0.1

Table J. FISH RULES FOR 1983

MACKEREL	BAT(m)	CHL(mg/m3)	SST(C)	MLD(m)	GC(mg/m3)	GS(C)
JAN	0 - 800	0 - 5	14 - 17	0 - 30	0 - 3	0 - 0.1
FEB	0 - 800	0 - 6	14 - 16	0 - 20	0 - 3	0 - 0.1
MAR	0 - 900	0 - 2	15 - 17	0 - 10	0 - 1	0 - 0.1
APR	0 - 900	0 - 6	15 - 16	0 - 50	0 - 3	0 - 0.1
MAY	0 - 1600	0 - 8	16 - 19	0 - 50	0 - 2	0 - 0.1
JUN	0 - 1600	0 - 3	15 - 18	0 - 40	0 - 2	0 - 0.1
JUL	0 - 1600	0 - 5	15 - 20	0	0 - 1	0 - 0.1
AUG	0 - 1600	0 - 3	19 - 23	0	0 - 0.5	0 - 0.1
SEP	0 - 1600	0 - 3	18 - 24	0	0 - 1	0 - 0.1
OCT	0 - 200	0 - 5	19 - 21	0 - 10	0 - 3	0 - 0.1
NOV	x	x	x	x	x	x
DEC	x	x	x	x	x	x

Table K. FISH RULES FOR 1983

SARDINE	BAT(m)	CHL(mg/m3)	SST(C)	MLD(m)	GC(mg/m3)	GS(C)
JAN	0 - 200	0 - 3	15 - 16	0 - 20	0 - 0.5	0 - 0.1
FEB	0 - 200	0 - 5	15 - 16	0 - 20	0 - 3	0 - 0.1
MAR	x	x	x	x	x	x
APR	100 - 600	0 - 6	15 - 16	0	0 - 3	0 - 0.1
MAY	x	x	x	x	x	x
JUN	x	x	x	x	x	x
JUL	0 - 600	0 - 3	18 - 19	0	0 - 1	0 - 0.1
AUG	0 - 200	0 - 2	20 - 21	0	0 - 2	0 - 0.1
SEP	0 - 300	0 - 2	20 - 22	0	0 - 0.5	0 - 0.1
OCT	x	x	x	x	x	x
NOV	x	x	x	x	x	x
DEC	x	x	x	x	x	x

Table L. FISH RULES FOR 1983

ANCHOVY	BAT(m)	CHL(mg/m3)	SST(C)	MLD(m)	GC(mg/m3)	GS(C)
JAN	100 - 500	0 - 4	16 - 17	0 - 10	0 - 0.5	0 - 0.1
FEB	100 - 500	0 - 4	15 - 16	0 - 10	0 - 1	0 - 0.1
MAR	100 - 500	0 - 2	16 - 17	0 - 10	0 - 0.5	0 - 0.1
APR	0 - 900	0 - 6	15 - 16	0 - 50	0 - 3	0 - 0.1
MAY	0 - 500	0 - 8	16 - 19	0	0 - 2	0 - 0.1
JUN	0 - 1200	0 - 1	16 -18	0 - 10	0 - 0.5	0 - 0.1
JUL	0 - 1400	0 - 2	17 - 20	0	0 - 1	0 - 0.1
AUG	100 - 1200	0 - 3	20 - 23	0	0 - 0.5	0 - 0.1
SEP	0 - 1000	0 - 2	19 - 23	0	0 - 1	0 - 0.1
OCT	x	x	x	x	x	x
NOV	x	x	x	x	x	x
DEC	x	x	x	x	x	x

Table M. Single Regressions for Tuna 1983

Month	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Yearly*
total obs	37	15	2	2	0	0	162	306	164	15	7	2	712
total effort	407	221	4	23	0	0	1797	2322	1176	88	84	11	6133
total tons	800	360	20	15	0	0	13932	27003	9964	1112	280	20	53506
#Pix /w fish	15	10	2	1	0	0	73	89	62	3	2	2	259
Bat(r)	0.13	0.11	x	x	x	x	0.13	0.08	0.15	x	x	x	0.02
Chl(r)	0.45	0.47	x	x	x	x	0.12	0.05	0.01	x	x	x	0.02
SST (r)	0.41	0.45	x	x	x	x	0.01	0.26	0.45	x	x	x	0.03
Mld (r)	0.4	0.33	x	x	x	x	x	x	x	x	x	x	0.05
GChl (r)	0.39	0.4	x	x	x	x	0.21	0.07	0.1	x	x	x	0.05
GSST(r)	x	x	x	x	x	x	0.09	0.1	0.06	x	x	x	0.09
Bat (t)	0.12	0.72	x	x	x	x	**2.91**	1.26	0.12	x	x	x	0.1
Chl (t)	0.18	0.29	x	x	x	x	**2.11**	0.89	0.68	x	x	x	0.52
SST(t)	0.11	2.19	x	x	x	x	0.77	**2.47**	**3.47**	x	x	x	0.58
Mld (t)	1.75	**2.9**	x	x	x	x	x	x	x	x	x	x	0.32
GChl (t)	0.27	0.21	x	x	x	x	**2.8**	0.8	0.76	x	x	x	1.32
GSST(t)	x	x	x	x	x	x	0.35	0.13	0.31	x	x	x	1.67
Book Val (t)	2.16	2.31	x	x	x	x	1.99	1.99	2	x	x	x	1.97
P = 0.975	Significant Ttest Are In Bold !												

Table N. Single Regressions for Mackerel 1983

Month	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Yearly*
total obs	146	40	8	158	156	53	82	71	54	8	1	0	777
total effort	1143	472	55	1022	1075	239	1045	868	669	138	42	0	6768
total tons	####	1783	198	39218	56605	7761	33330	11641	8975	377	1	0	182445
#Pix /w fish	52	18	6	38	44	19	40	32	25	6	1	0	281
Bat(r)	0.02	0.04	x	0.01	0.03	0.09	0.14	0.54	0.28	x	x	x	0.02
Chl(r)	0.21	0.13	x	0.38	0.17	0.18	0.16	0.31	0.03	x	x	x	0.01
SST (r)	0.42	0.68	x	0.26	0.31	0.12	0.25	0.66	0.02	x	x	x	0.11
Mld (r)	0.33	0.31	x	0.34	0.05	0.1	x	x	x	x	x	x	0.04
GChl (r)	0.05	0.04	x	0.01	0.17	0.19	0.25	0.48	0.08	x	x	x	0.05
GSST(r)	x	x	x	0.12	0.19	x	0.12	0.22	0.07	x	x	x	0.05
Bat (t)	1.53	0.95	x	0.95	0.18	0.07	**2.38**	0.8	1.14	x	x	x	0.55
Chl (t)	0.44	0.32	x	**2.68**	0.92	0.37	1.59	0.36	0.65	x	x	x	0.38
SST(t)	**2.09**	**3.35**	x	0.85	2	0.46	**2.05**	**4.41**	0.3	x	x	x	1.83
Mld (t)	0.38	0.21	x	1.39	0.07	0.25	x	x	x	x	x	x	0.58
GChl (t)	0.01	0.3	x	0.6	0.68	0.53	1.24	1.71	0.32	x	x	x	1.33
GSST(t)	x	x	x	1.39	0.8	x	1.76	0.03	0.14	x	x	x	0.15
Book Val (t)	2.01	2.12	x	2.03	2.02	2.11	2.02	2.04	2.07	x	x	x	1.97
P = 0.975	Significant Ttest Are In Bold !												

Table O. Single Regressions for Sardine 1983

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
total obs	2	5	0	6	1	0	3	4	10	0	0	0	31
total effort	42	140	0	197	48	0	112	118	198	0	0	0	855
total tons	40	370	0	850	50	0	230	50	210	0	0	0	1800
#Pix /w fish	2	5	0	5	1	0	3	4	5	0	0	0	25
Bat(r)	x	x	x	x	x	x	x	x	x	x	x	x	0.46
Chl(r)	x	x	x	x	x	x	x	x	x	x	x	x	0.67
SST (r)	x	x	x	x	x	x	x	x	x	x	x	x	0.31
Mld (r)	x	x	x	x	x	x	x	x	x	x	x	x	0.07
GChl (r)	x	x	x	x	x	x	x	x	x	x	x	x	0.11
GSST(r)	x	x	x	x	x	x	x	x	x	x	x	x	0.25
Bat (t)	x	x	x	x	x	x	x	x	x	x	x	x	1.08
Chl (t)	x	x	x	x	x	x	x	x	x	x	x	x	**4.16**
SST(t)	x	x	x	x	x	x	x	x	x	x	x	x	0.89
Mld (t)	x	x	x	x	x	x	x	x	x	x	x	x	0.35
GChl (t)	x	x	x	x	x	x	x	x	x	x	x	x	1.34
GSST(t)	x	x	x	x	x	x	x	x	x	x	x	x	0.46
Book Val (t)	x	x	x	x	x	x	x	x	x	x	x	x	2.07
P = 0.975	Significant Ttest Are In Bold !												

Table P. Single Regressions for Anchovy 1983

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
total obs	3	7	0	54	25	25	30	39	26	0	0	0	209
total effort	78	134	0	690	629	207	661	979	561	0	0	0	3939
total tons	35	282	0	22905	9640	7745	1450	5136	1970	0	0	0	49163
#Pix /w fish	2	5	0	25	14	11	23	26	23	0	0	0	129
Bat(r)	x	x	x	0.13	0.31	0.54	0.37	0.2	0.18	x	x	x	0.08
Chl(r)	x	x	x	0.05	0.14	0.14	0.27	0.21	0.12	x	x	x	0.11
SST (r)	x	x	x	0.11	0.28	0.69	0.12	0.14	0.29	x	x	x	0.28
Mld (r)	x	x	x	0.04	0.07	0.14	x	x	x	x	x	x	0.06
GChl (r)	x	x	x	0.09	0.17	0.38	0.24	0.14	0.14	x	x	x	0.07
GSST(r)	x	x	x	0.09	0.06	x	0.02	0.29	0.1	x	x	x	0.11
Bat (t)	x	x	x	0.31	0.83	1.57	0.51	1.57	0.35	x	x	x	0.39
Chl (t)	x	x	x	0.03	0.58	0.7	0.55	1.05	0.84	x	x	x	0.2
SST(t)	x	x	x	0.17	1.35	0.86	0.77	0.03	1.25	x	x	x	**2.85**
Mld (t)	x	x	x	0.09	0.36	1.64	x	x	x	x	x	x	0.04
GChl (t)	x	x	x	0.12	0.55	1.89	0.32	1.51	0.23	x	x	x	0.34
GSST(t)	x	x	x	0.17	0.87	x	0.12	1.97	0.11	x	x	x	0.06
Book Val (t)	x	x	x	2.07	2.18	2.26	2.08	2.06	2.08	x	x	x	1.98
P = 0.975	Significant Ttest Are In Bold !												

Table Q. Single Regressions for Tuna 1986

Month	Jan	Feb	Mar	Apr	May	Jun	Yearly
total obs	17	6	4	8	31	206	272
total effort	116	4	1	18	8	11	258
total tons	900	70	50	98	110	414	1642
#Pix /w fish	2	2	1	2	5	14	26
Bat(r)	x	x	x	x	x	0.06	0.21
Chl(r)	x	x	x	x	x	0.54	0.12
SST (r)	x	x	x	x	x	0.56	0.54
Mld (r)	x	x	x	x	x	0.5	0.15
GChl (r)	x	x	x	x	x	0.16	0.01
GSST(r)	x	x	x	x	x	0.24	0.63
Bat (t)	x	x	x	x	x	0.59	1.14
Chl (t)	x	x	x	x	x	**3.55**	0.86
SST(t)	x	x	x	x	x	0.2	1.47
Mld (t)	x	x	x	x	x	0.73	0.62
GChl (t)	x	x	x	x	x	0.44	0.38
GSST(t)	x	x	x	x	x	1.54	**2.79**
Book Val (t)	x	x	x	x	x	2.179	2.064
P = 0.975	Significant Ttest Are In Bold!						

Table R. Single Regressions for Mackerel 1986

Month	Jan	Feb	Mar	Apr	May	Jun	Yearly
total obs	146	168	98	230	389	894	1925
total effort	534	263	113	413	345	525	2193
total tons	36080	26640	6351	23362	140125	149535	382093
#Pix /w fish	18	15	12	19	33	51	148
Bat(r)	0.44	0.37	0.41	0.28	0.12	0.04	0.02
Chl(r)	0.09	0.15	0.12	0.24	0.21	0.01	0.13
SST (r)	0.35	0.43	0.34	0.22	0.03	0.32	0.01
Mld (r)	0.05	0.06	0.33	0.24	0.14	0.08	0.07
GChl (r)	0.67	0.25	0.17	0.35	0.28	0.1	0.09
GSST(r)	0.13	0.33	0.09	0.09	0.13	0.01	0.04
Bat (t)	1.09	0.56	0.44	0.32	**2.63**	0.77	1.16
Chl (t)	1.08	0.16	0.43	0.42	1.61	0.1	1.76
SST(t)	0.38	**2.68**	0.39	0.61	1.45	**3.5**	0.51
Mld (t)	0.1	1.06	0.68	0.61	1.65	0.87	1.09
GChl (t)	**2.48**	0.56	0.48	1.06	1.91	1.21	0.74
GSST(t)	0.09	**2.53**	1.1	0.77	1.01	**2.31**	0.76
Book Val (t)	2.12	2.16	2.23	2.11	2.04	2.01	1.98
P = 0.975	Significant Ttest Are In Bold!						

Table S. Single Regressions for Sardine 1986

Month	Jan	Feb	Mar	Apr	May	Jun	Yearly
total obs	180	54	37	220	209	456	1156
total effort	536	170	39	645	461	311	2162
total tons	19500	21400	21500	29508	51736	23600	167244
#Pix /w fish	22	8	4	16	17	19	86
Bat(r)	0.09	0.42	x	0.01	0.08	0.5	0.07
Chl(r)	0.12	0.33	x	0.05	0.42	0.3	0.12
SST (r)	0.34	0.35	x	0.08	0.01	0.12	0.13
Mld (r)	0.09	x	x	0.06	0.28	0.08	0.01
GChl (r)	0.26	0.39	x	0.53	0.3	0.14	0.03
GSST(r)	0.26	0.28	x	0.17	0.05	0.23	0.12
Bat (t)	0.27	0.96	x	0.44	1.32	1.76	0.6
Chl (t)	0.37	0.75	x	0.08	2.07	1.24	1.73
SST(t)	0.84	0.24	x	0.03	1.39	0.57	1.54
Mld (t)	0.32	x	x	0.02	0.44	0.07	0.08
GChl (t)	0.6	0.69	x	1.92	0.4	1.65	0.12
GSST(t)	0.58	0.64	x	0.6	0.72	1.05	1.28
Book Val (t)	2.09	2.45	x	2.15	2.13	2.11	1.99
P = 0.975	Significant Ttest Are In Bold!						

Table T. Single Regressions for Anchovy 1986

Month	Jan	Feb	Mar	Apr	May	Jun	Yearly
total obs	71	172	114	139	152	220	868
total effort	32	189	36	228	15	78	578
total tons	6593	21351	10819	6559804	825434	54453	7478454
#Pix /w fish	5	13	11	15	11	20	75
Bat(r)	x	0.37	0.59	0.53	0.32	0.29	0.25
Chl(r)	x	0.16	0.2	0.76	0.36	0.47	0.23
SST (r)	x	0.14	0.37	0.66	0.32	0.78	0.26
Mld (r)	x	x	x	0.1	0.37	0.6	0.01
GChl (r)	x	0.67	0.38	0.01	0.38	0.05	0.02
GSST(r)	x	0.58	0.01	0.31	0.25	0.68	0.19
Bat (t)	x	1.3	1.1	0.39	0.19	0.46	1.49
Chl (t)	x	1.16	0.64	1.47	0.89	0.31	0.99
SST(t)	x	0.15	0.43	1.03	0.81	1.7	0.85
Mld (t)	x	x	x	0.11	1.26	0.98	0.07
GChl (t)	x	**3.69**	1.21	1.49	0.29	0.44	1.53
GSST(t)	x	**2.78**	1.5	0.01	0.32	0.15	1.3
Book Val (t)	x	2.2	2.26	2.16	2.26	2.1	1.99
P = 0.975	Significant Ttest Are In Bold!						

Table U. Multiple Regression Analysis / Verification for 1983

Species	Month	total obs	total effort	total tons	#pix/w fish	mult	Ftest	Book Val	Sig / Non Sig
Tuna	Jan	37	407	800	15	0.65	1.35	0.21	S
	Feb	15	221	360	10	0.89	2.91	0.193	S
	Mar	2	4	20	2	X	X	X	X
	Apr	2	23	15	1	X	X	X	X
	May	0	0	0	0	X	X	X	X
	Jun	0	0	0	0	X	X	X	X
	Jul	162	1797	13932	73	0.41	2.77	0.226	S
	Aug	306	2322	27003	89	0.32	1.85	0.224	S
	Sep	164	1176	9964	62	0.47	3.21	0.226	S
	Oct	15	88	1112	3	X	X	X	X
	Nov	7	84	280	2	X	X	X	X
	Dec	2	11	20	2	X	X	X	X
	Yearly	712	6133	53506	259	0.14	0.81	0.273	S
Mackerel	Jan	146	1143	22556	52	0.47	2.6	0.224	S
	Feb	40	472	1783	18	0.74	2.97	0.214	S
	Mar	8	55	198	6	X	X	X	X
	Apr	158	1022	39218	38	0.57	2.46	0.263	S
	May	156	1075	56605	44	0.41	1.23	0.265	S
	Jun	53	239	7761	19	0.26	0.18	0.214	NS
	Jul	82	1045	33330	40	0.53	2.65	0.222	S
	Aug	71	868	11641	32	0.8	9.04	0.221	S
	Sep	54	669	8975	25	0.33	0.47	0.219	S
	Oct	8	138	377	6	X	X	X	X
	Nov	1	42	1	1	X	X	X	X
	Dec	0	0	0	0	X	X	X	X
	Yearly	777	6768	182445	281	0.15	1.01	0.273	S
Sardine	Jan	2	42	40	2	X	X	X	X
	Feb	5	140	370	5	X	X	X	X
	Mar	0	0	0	0	X	X	X	X
	Apr	6	197	850	5	X	X	X	X
	May	1	48	50	1	X	X	X	X
	Jun	0	0	0	0	X	X	X	X
	Jul	3	112	230	3	X	X	X	X
	Aug	4	118	50	4	X	X	X	X
	Sep	10	198	210	5	X	X	X	X
	Oct	0	0	0	0	X	X	X	X
	Nov	0	0	0	0	X	X	X	X
	Dec	0	0	0	0	X	X	X	X
	Yearly	31	855	1800	25	0.8	5.18	0.258	S

Table U. Multiple Regression Analysis / Verification for 1983

Anchovy	Jan	3	78	35	2	X	X	X	X
	Feb	7	134	282	5	X	X	X	X
	Mar	0	0	0	0	X	X	X	X
	Apr	54	690	22905	25	0.15	0.07	0.258	NS
	May	25	629	9640	14	0.56	0.53	0.238	S
	Jun	25	207	7745	11	0.89	3.8	0.198	S
	Jul	30	661	1450	23	0.41	0.68	0.216	S
	Aug	39	979	5136	26	0.47	1.16	0.219	S
	Sep	26	561	1970	23	0.39	0.61	0.216	S
	Oct	0	0	0	0	X	X	X	X
	Nov	0	0	0	0	X	X	X	X
	Dec	0	0	0	0	X	X	X	X
	Yearly	209	3939	49163	129	0.29	1.85	0.27	S

Table V. Multiple Regression Analysis / Verification for 1986

Species	*Month*	*total obs*	*total effort*	*total tons*	*#pix/w fish*	*mult*	*Ftest*	*Book Val*	*Sig / Non Sig*
Tuna	Jan	3	17	900	2	X	X	X	X
	Feb	2	6	70	2	X	X	X	X
	Mar	1	4	50	1	X	X	X	X
	Apr	3	8	98	2	X	X	X	X
	May	6	31	110	5	X	X	X	X
	Jun	26	206	414	14	0.91	5.42	0.238	S
	Yearly	41	272	1642	26	0.74	3.81	0.258	S
Mackerel	Jan	40	146	36080	18	0.74	2.28	0.248	S
	Feb	31	168	26640	15	0.81	2.41	0.241	S
	Mar	18	98	6351	12	0.61	0.5	0.228	S
	Apr	52	230	23362	19	0.51	0.7	0.25	S
	May	96	389	140125	33	0.64	2.99	0.26	S
	Jun	140	894	149535	51	0.49	2.28	0.265	S
	Yearly	377	1925	382093	148	0.21	1.05	0.273	S
Sardine	Jan	32	180	19500	22	0.43	0.56	0.254	S
	Feb	10	54	21400	8	0.68	0.34	0.167	S
	Mar	10	37	21500	4	X	X	X	X
	Apr	36	220	29508	16	0.58	0.75	0.244	S
	May	31	209	51736	17	0.66	1.28	0.246	S
	Jun	27	456	23600	19	0.7	1.89	0.25	S
	Yearly	146	1156	167244	86	0.27	1.05	0.267	S
Anchovy	Jan	6	71	6593	5	X	X	X	X
	Feb	27	172	21351	13	0.89	5.61	0.205	S
	Mar	27	114	10819	11	0.84	2.43	0.198	S
	Apr	44	139	6559804	15	0.86	3.85	0.241	S
	May	50	152	825434	11	0.64	0.47	0.221	S
	Jun	34	220	54453	20	0.82	4.32	0.25	S
	Yearly	188	868	7478454	75	0.39	1.96	0.267	S

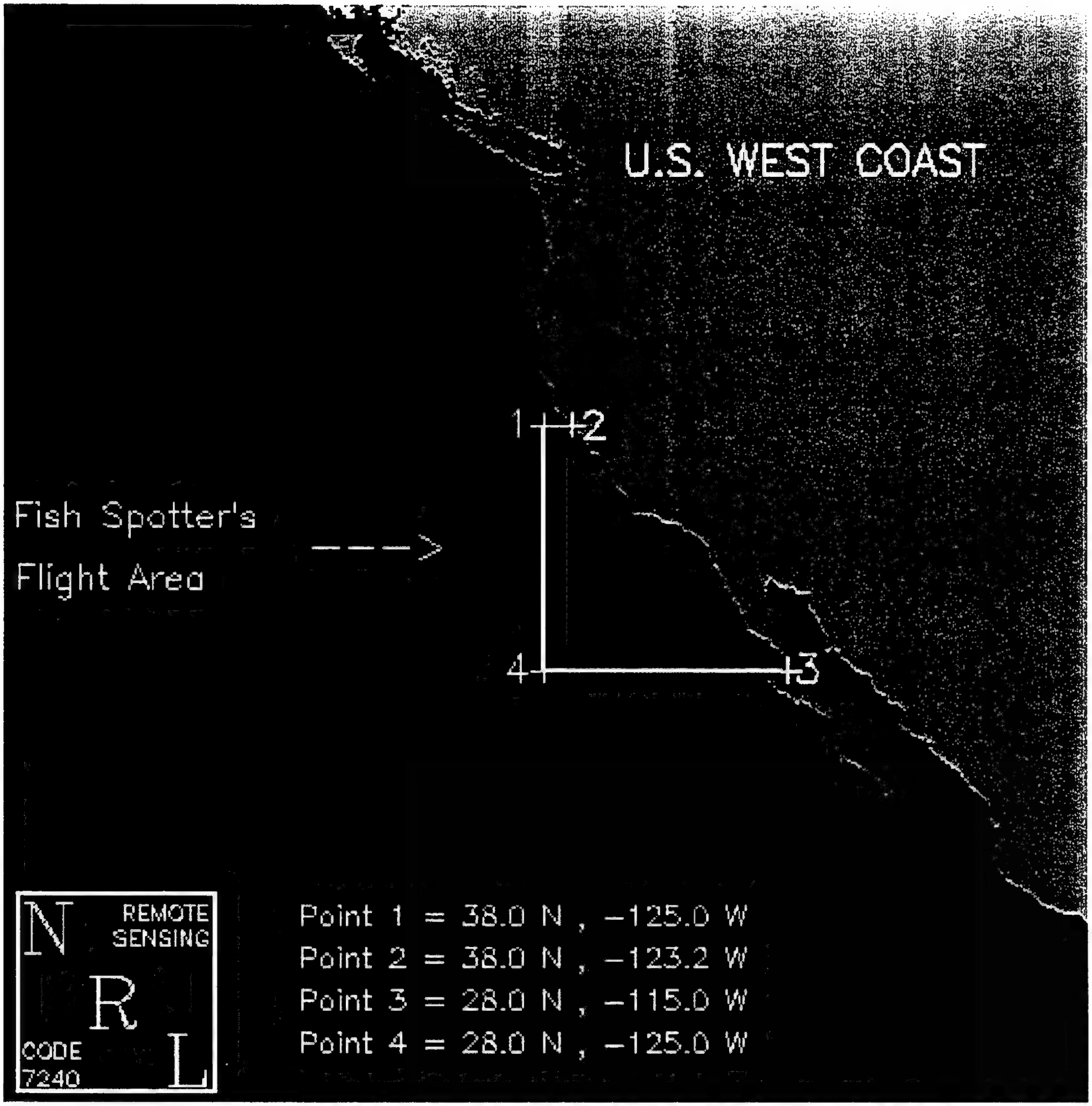


Figure 1. Spotter pilot's flight boundaries. The Pixel Resolution is 20 km.

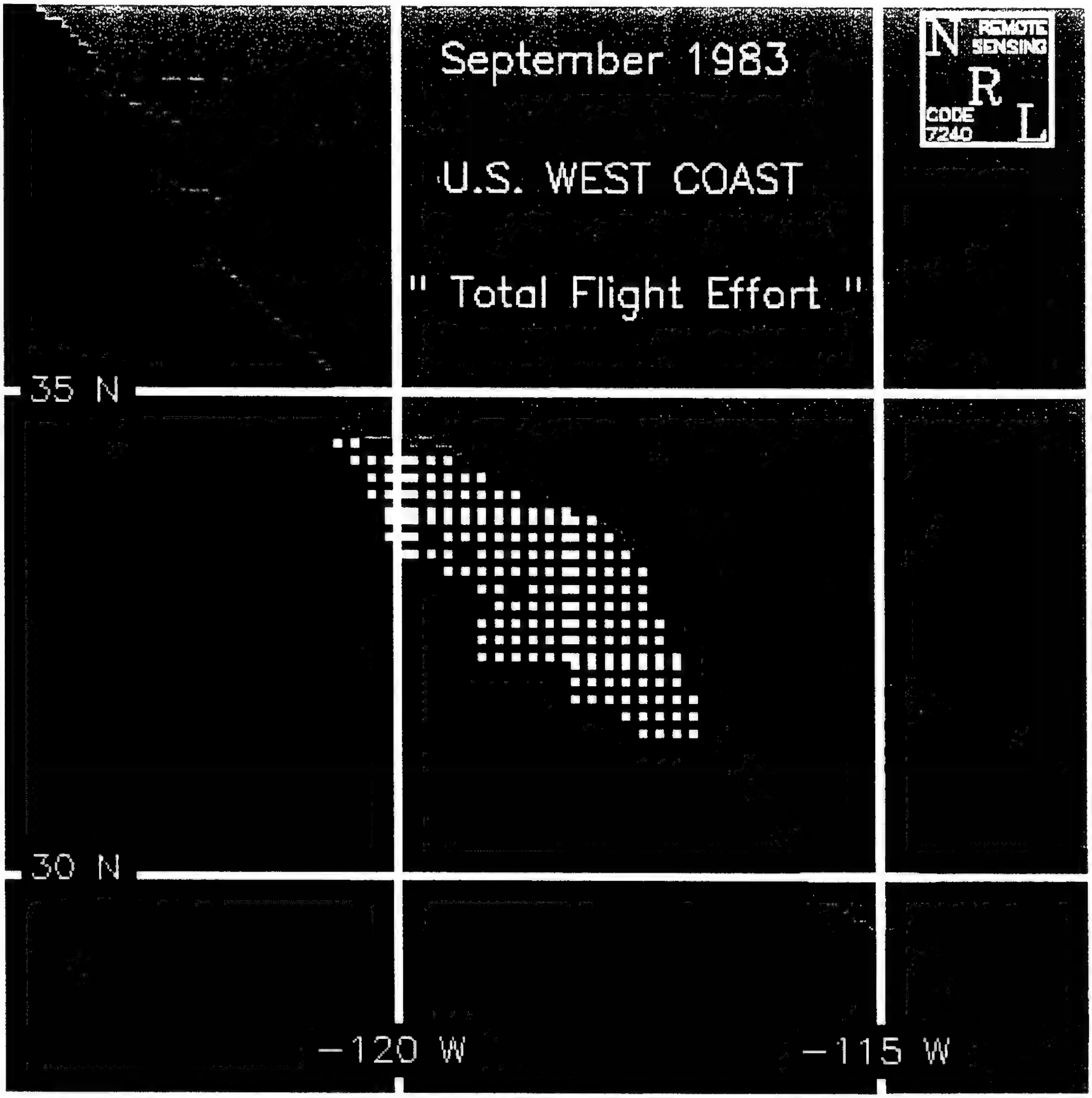


Figure 2. An example image of the total number of cells observed for the flight effort during September 1983. The pixel resolution is 20 km.

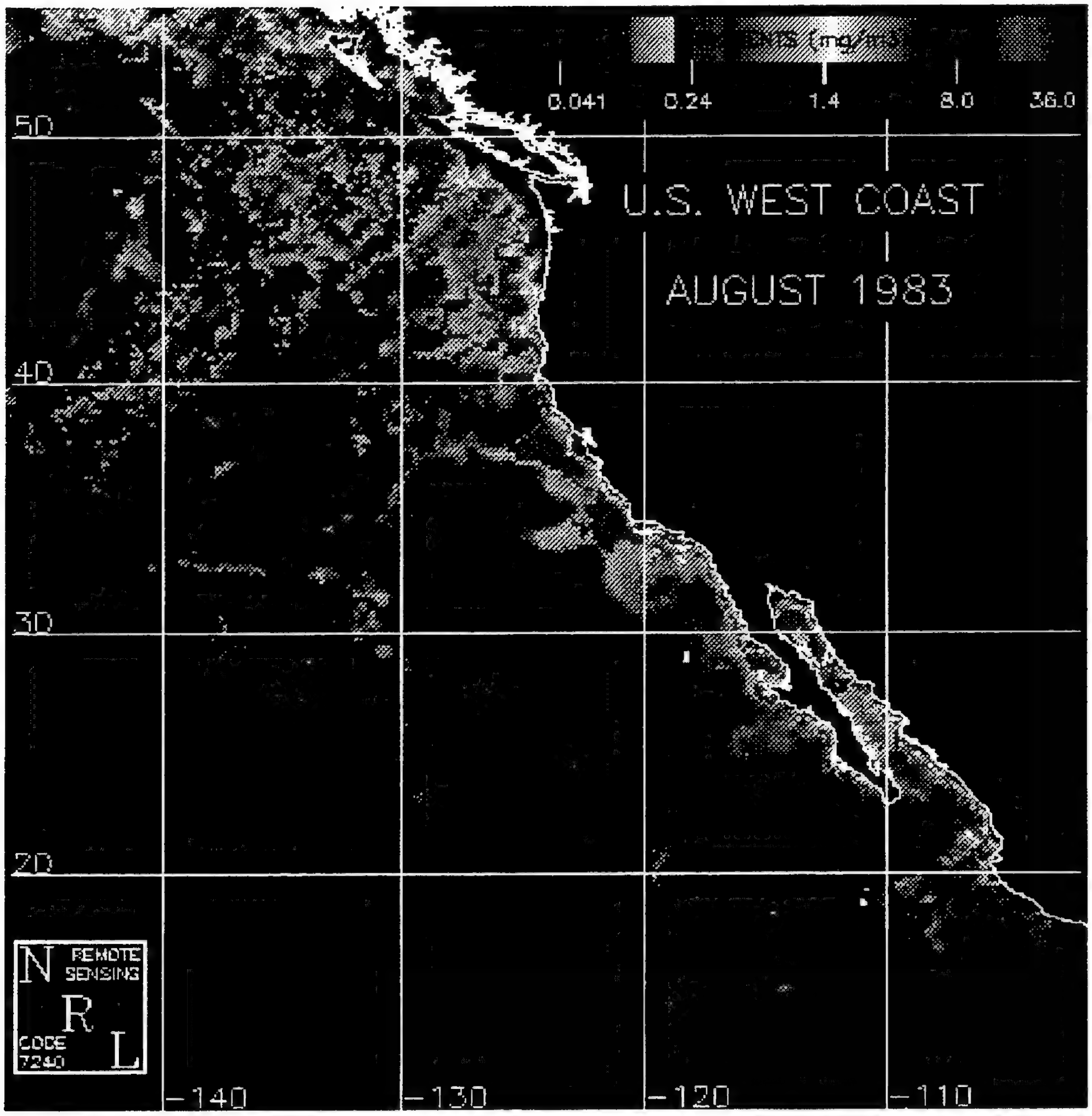


Figure 3. A database example of the pigment chlorophyll distribution for August 1983.

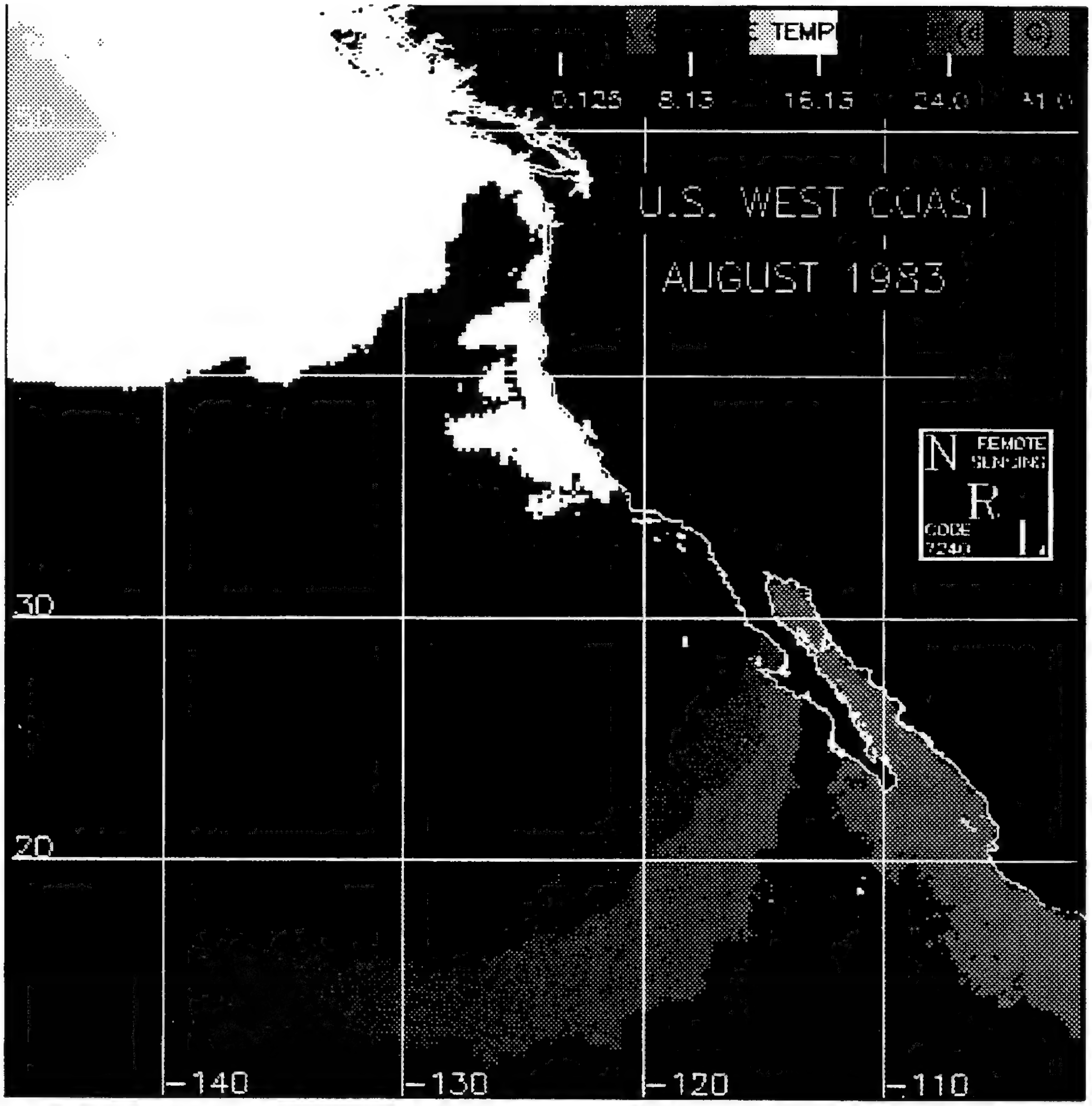


Figure 4. An example of the Sea Surface Temperature database for August 1983.

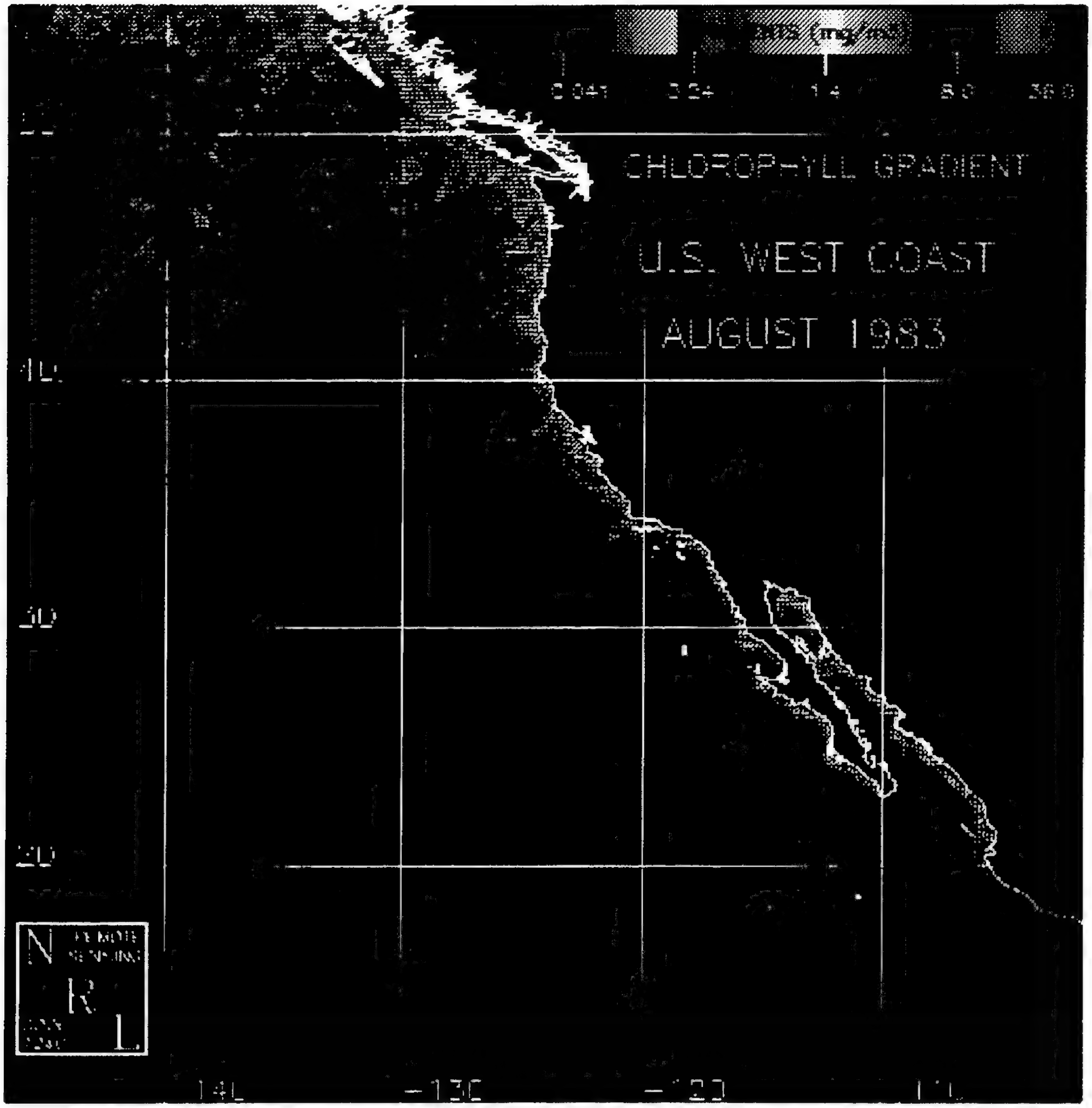


Figure 5. A database example of the spatial gradient of the chlorophyll variability for August 1983.

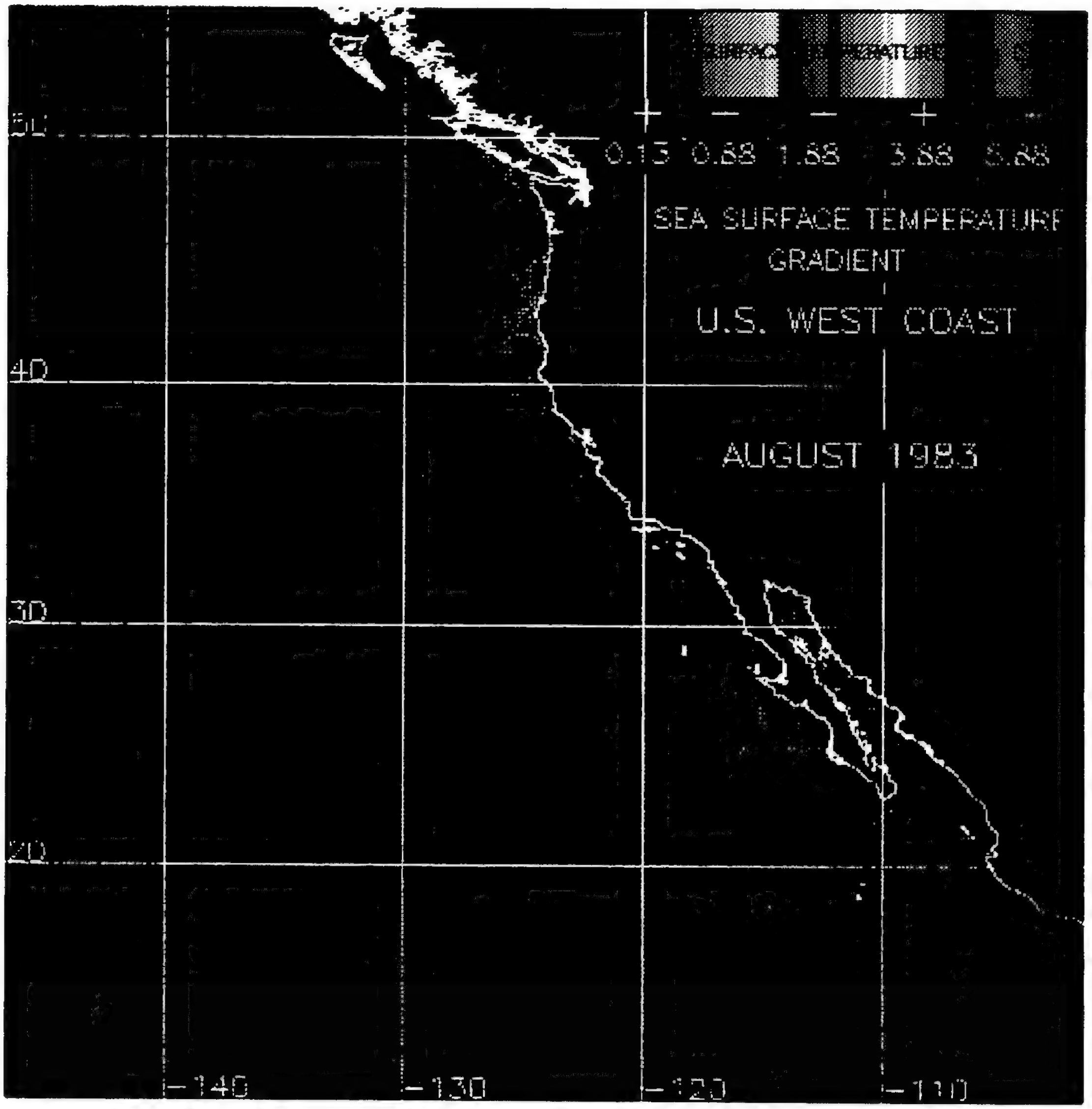


Figure 6. An example of the Sea Surface Temperature gradient for August 1983.

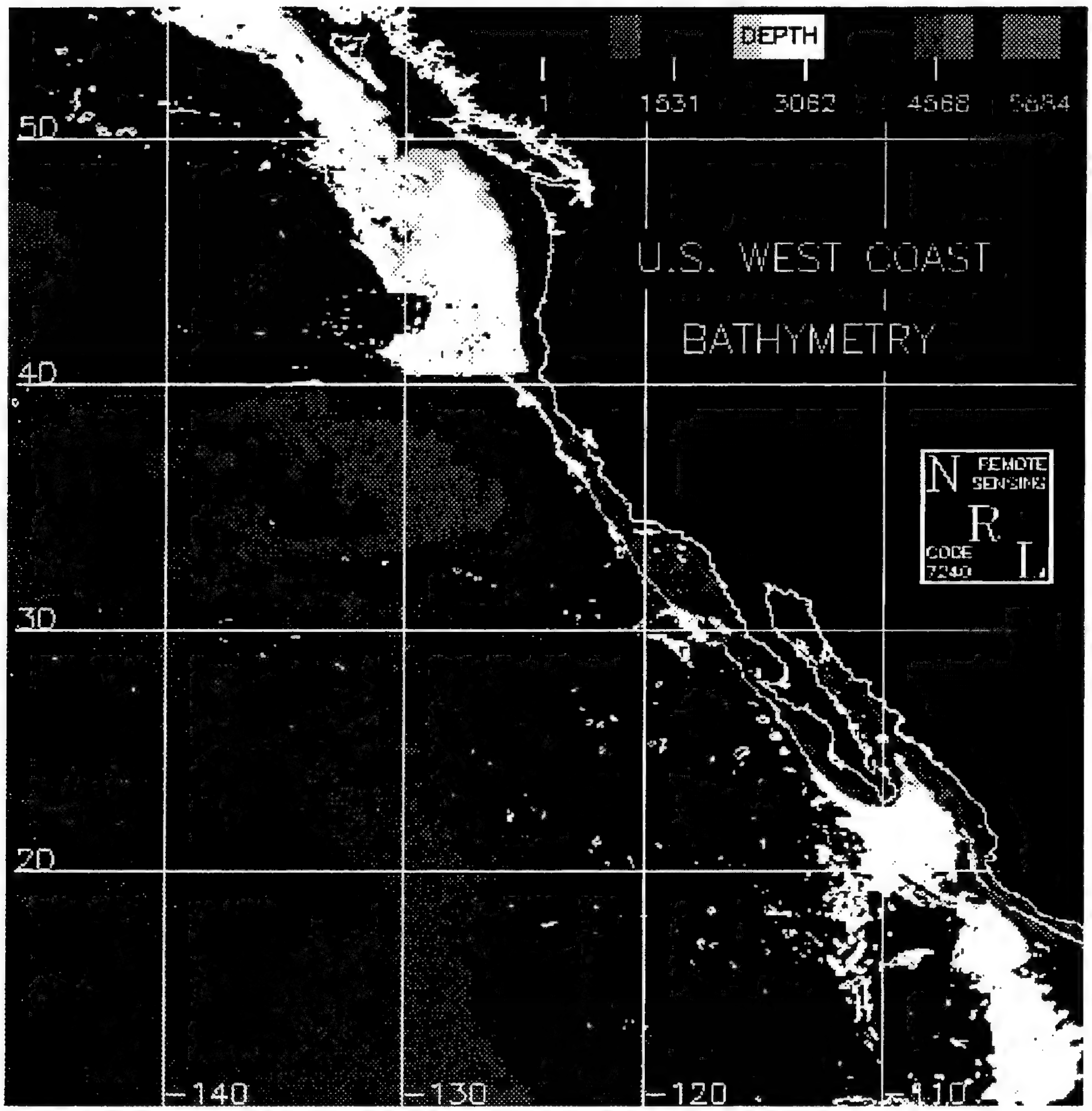


Figure 7. An example of the bathymetry database from August 1983.

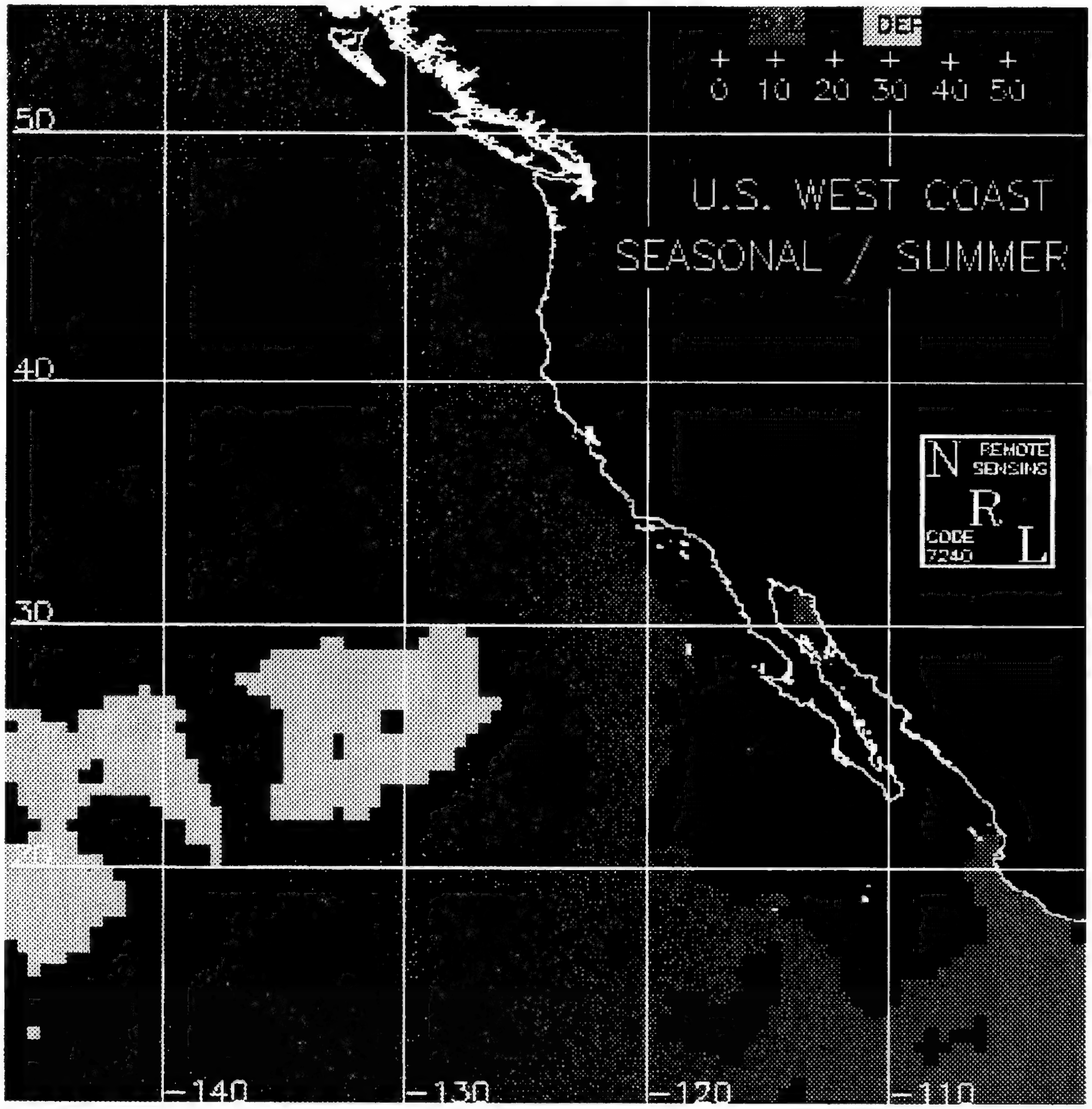


Figure 8. An example of the seasonal mixed layer depth database from August 1983.

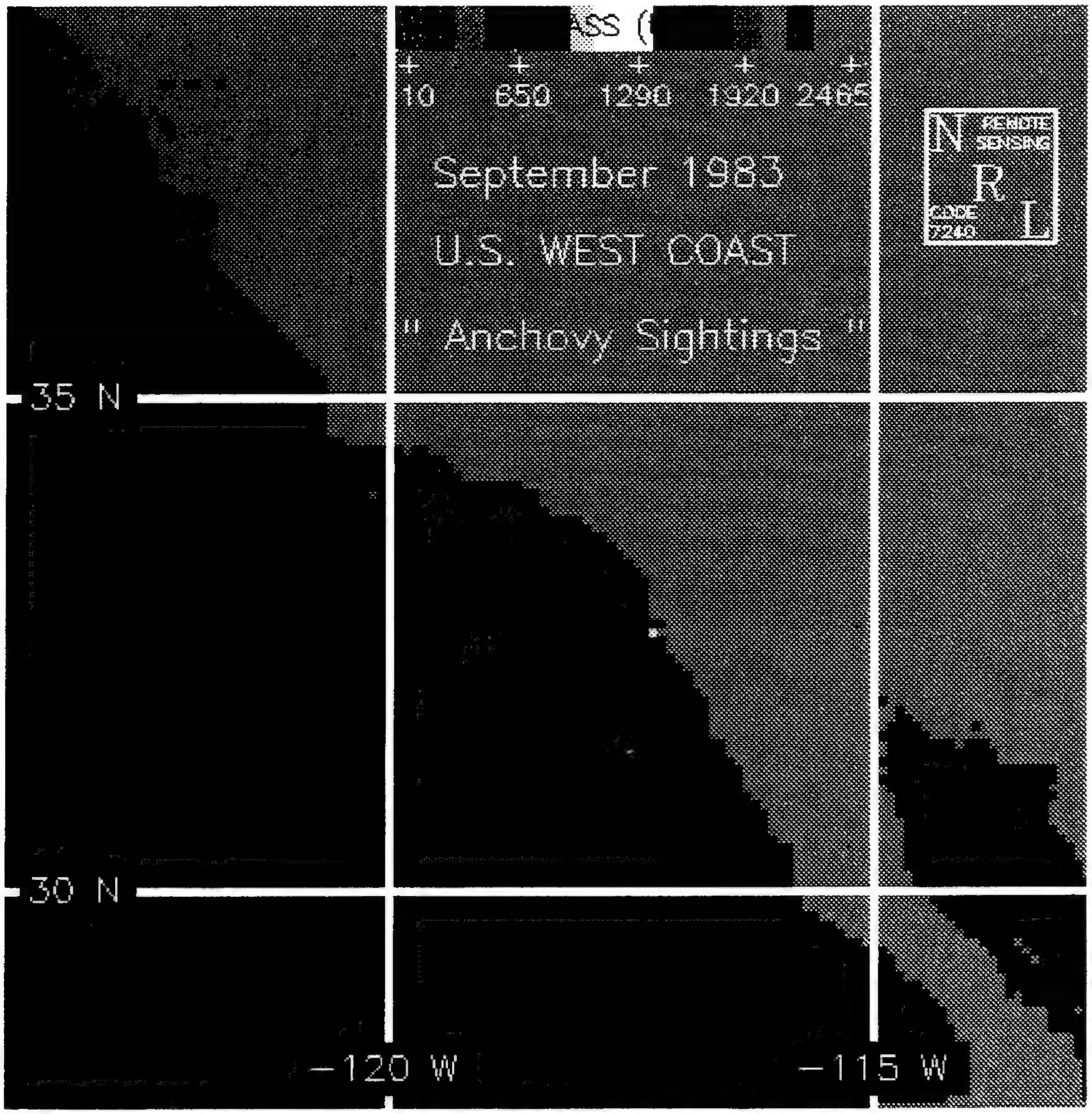


Figure 9. An example of the anchovy sighting locations for September 1983.

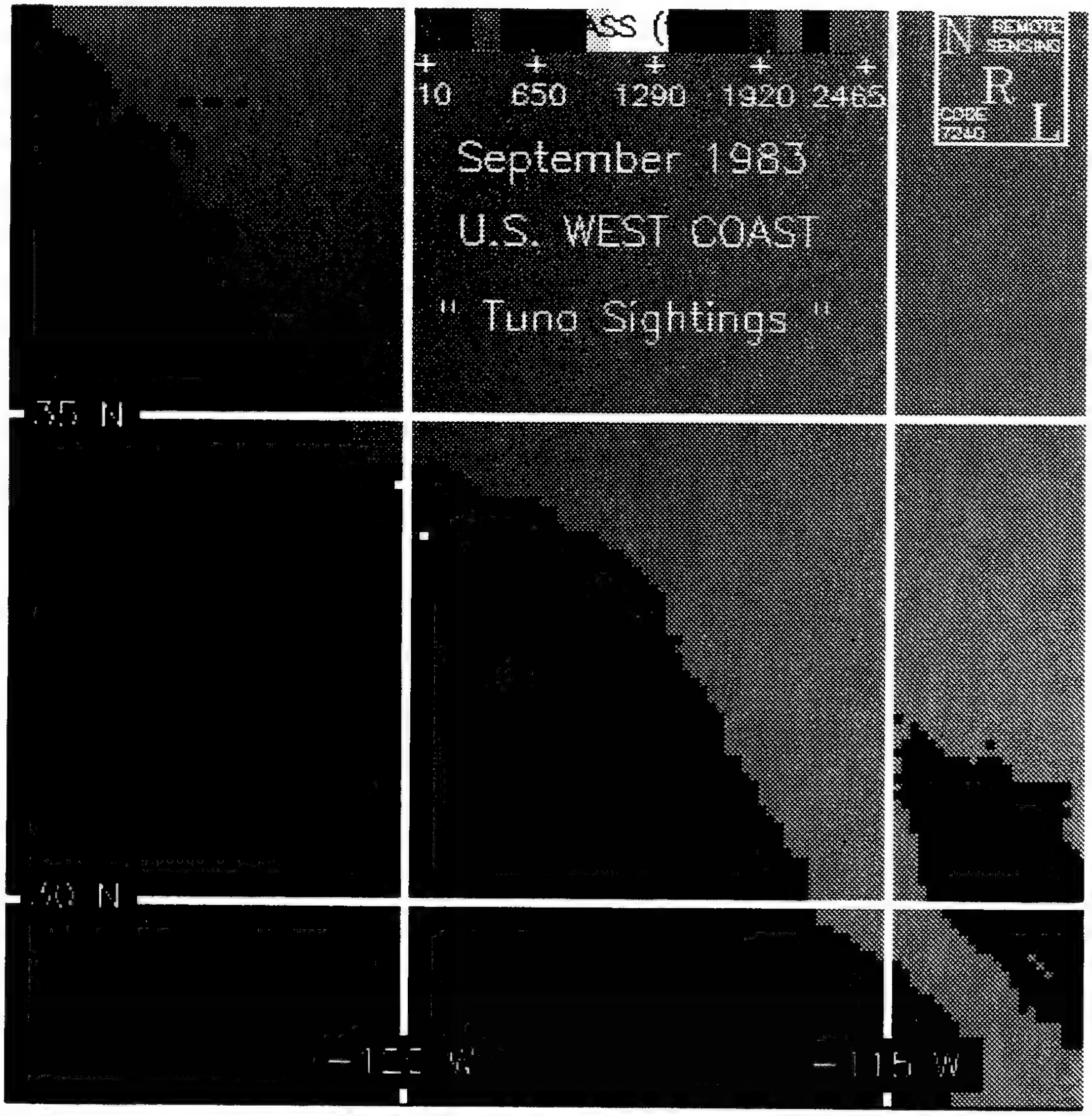


Figure 10. An example of the tuna sighting locations for September 1983.

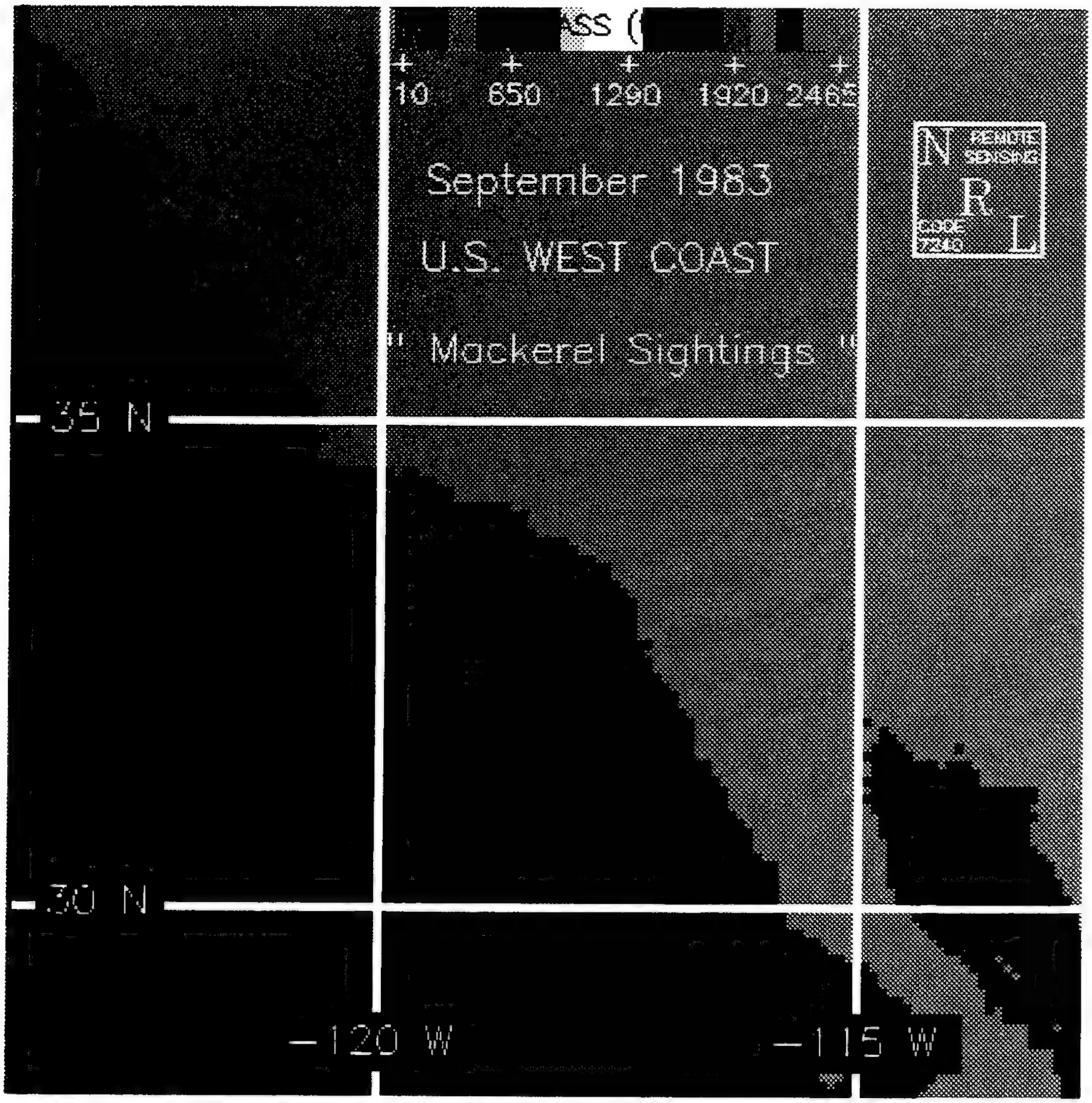


Figure 11. **An example image of the mackerel sighting locations for September 1983.**

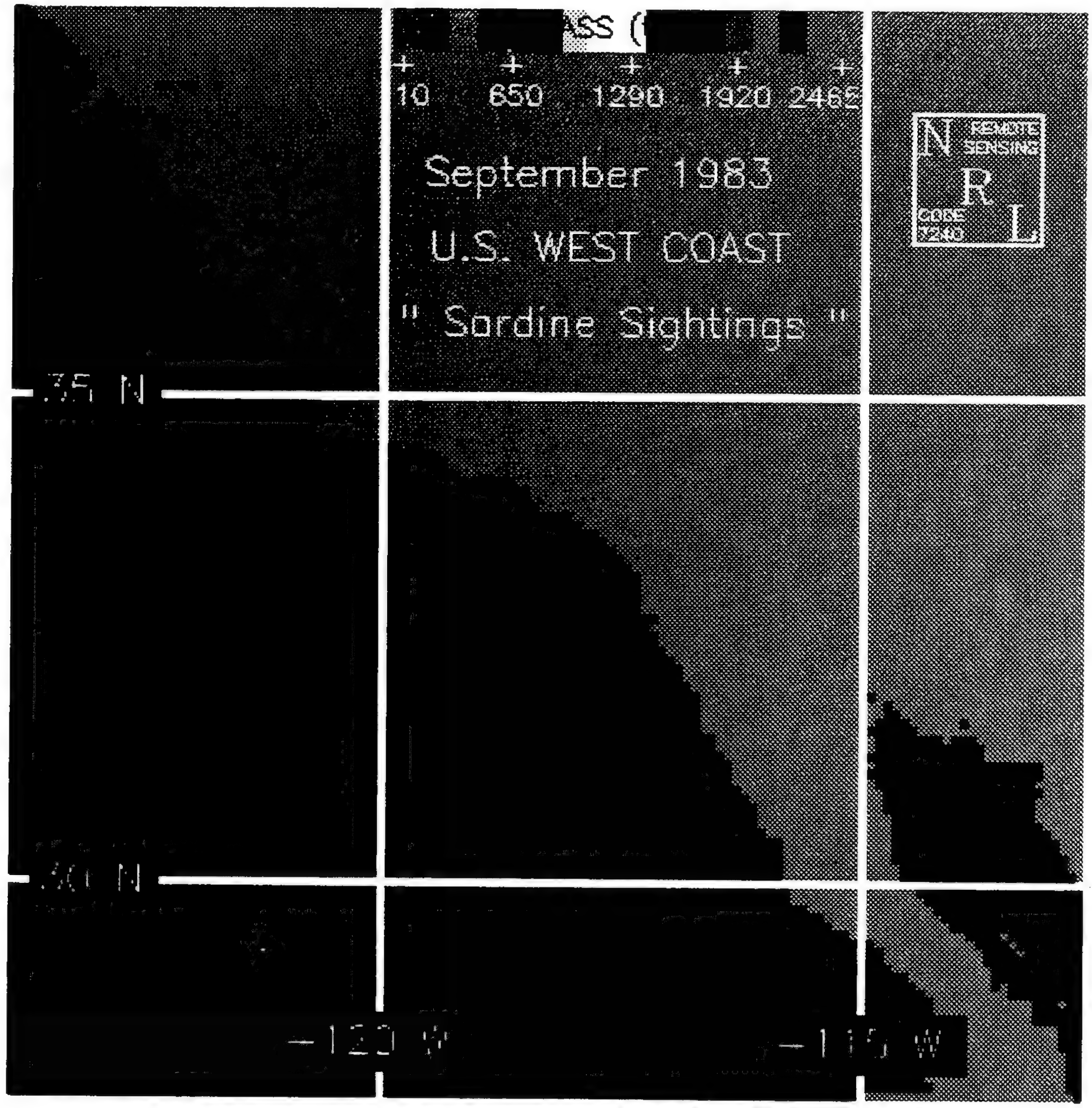


Figure 12. An example image of the sardine sighting locations for September 1983.

Figure 13

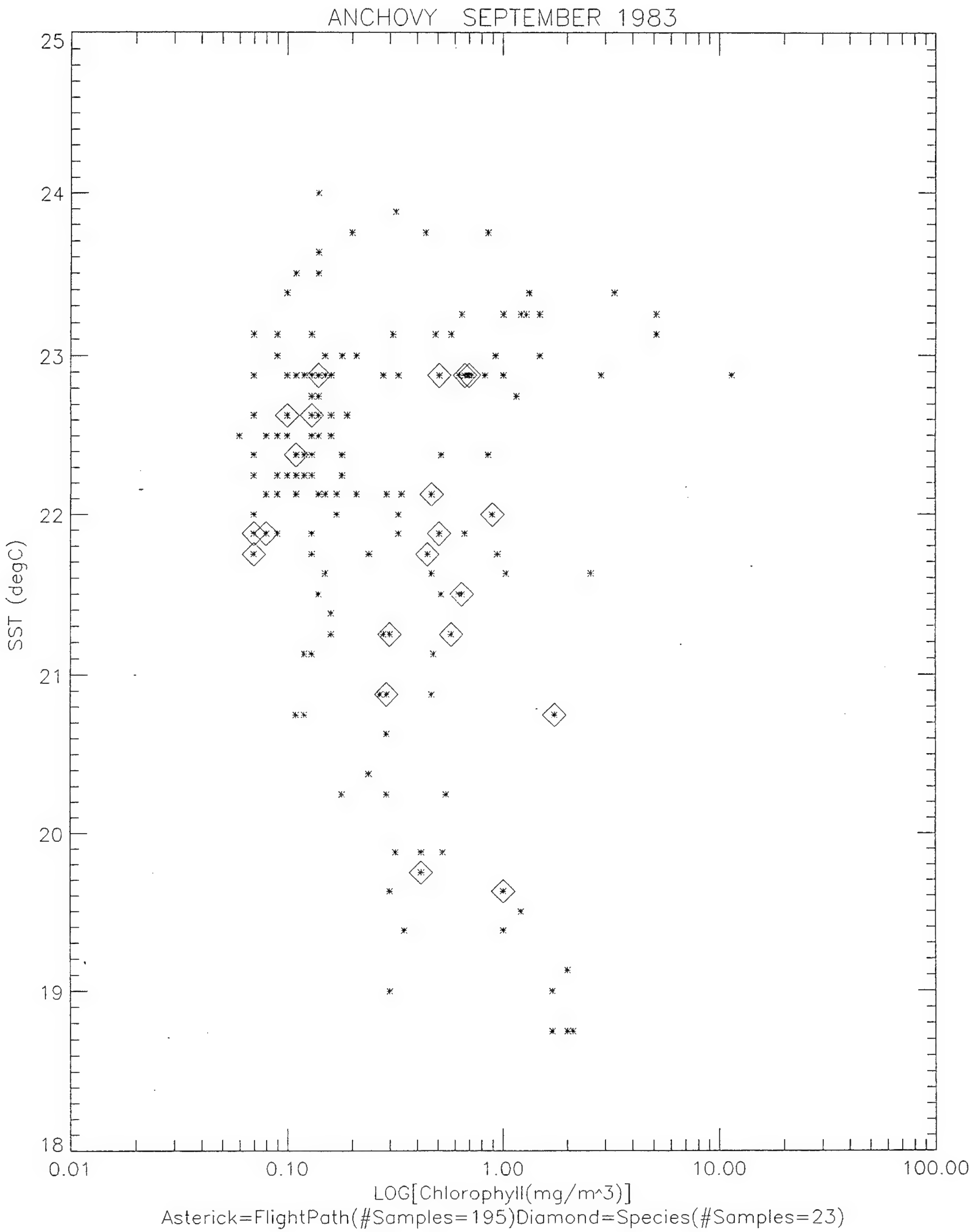
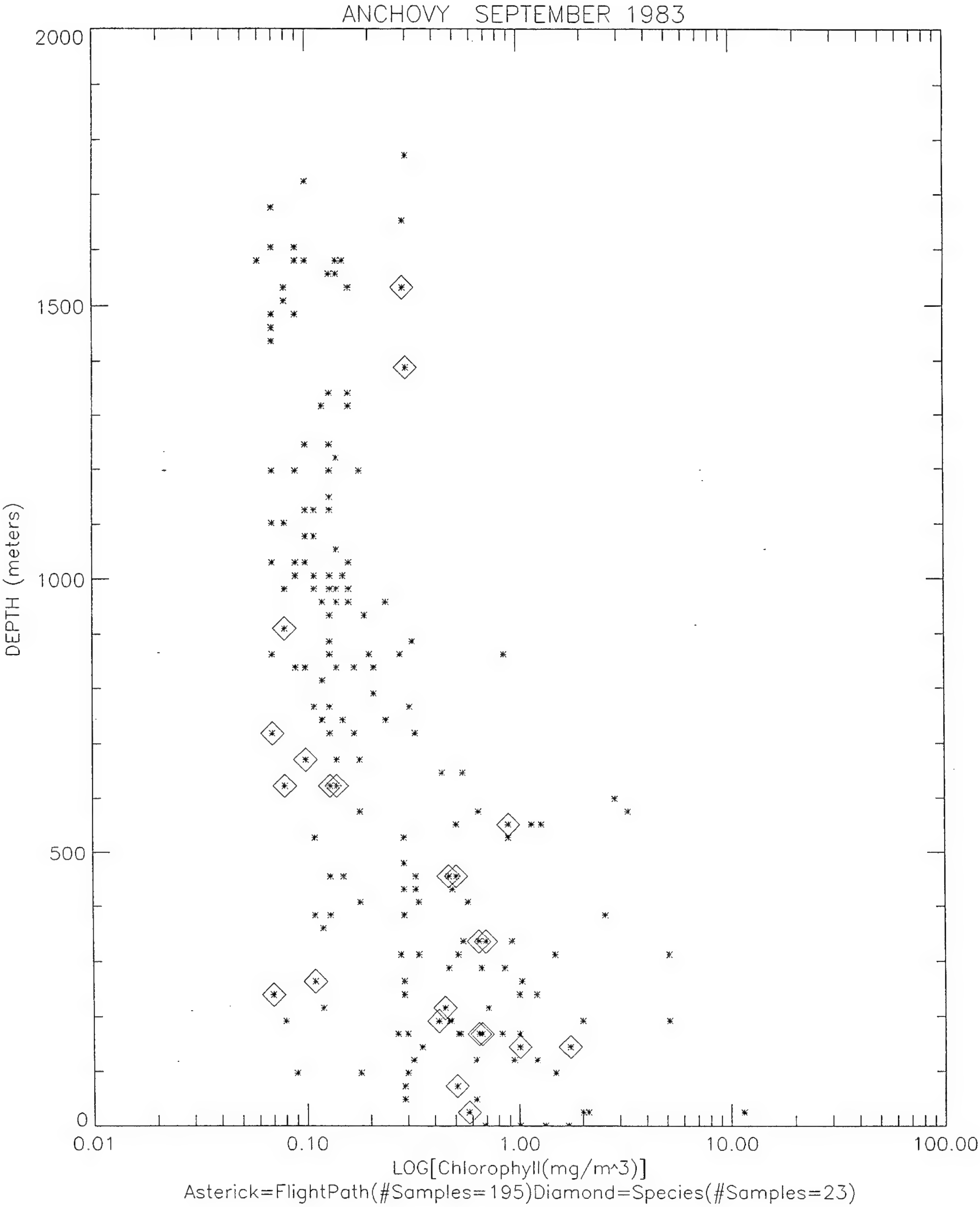
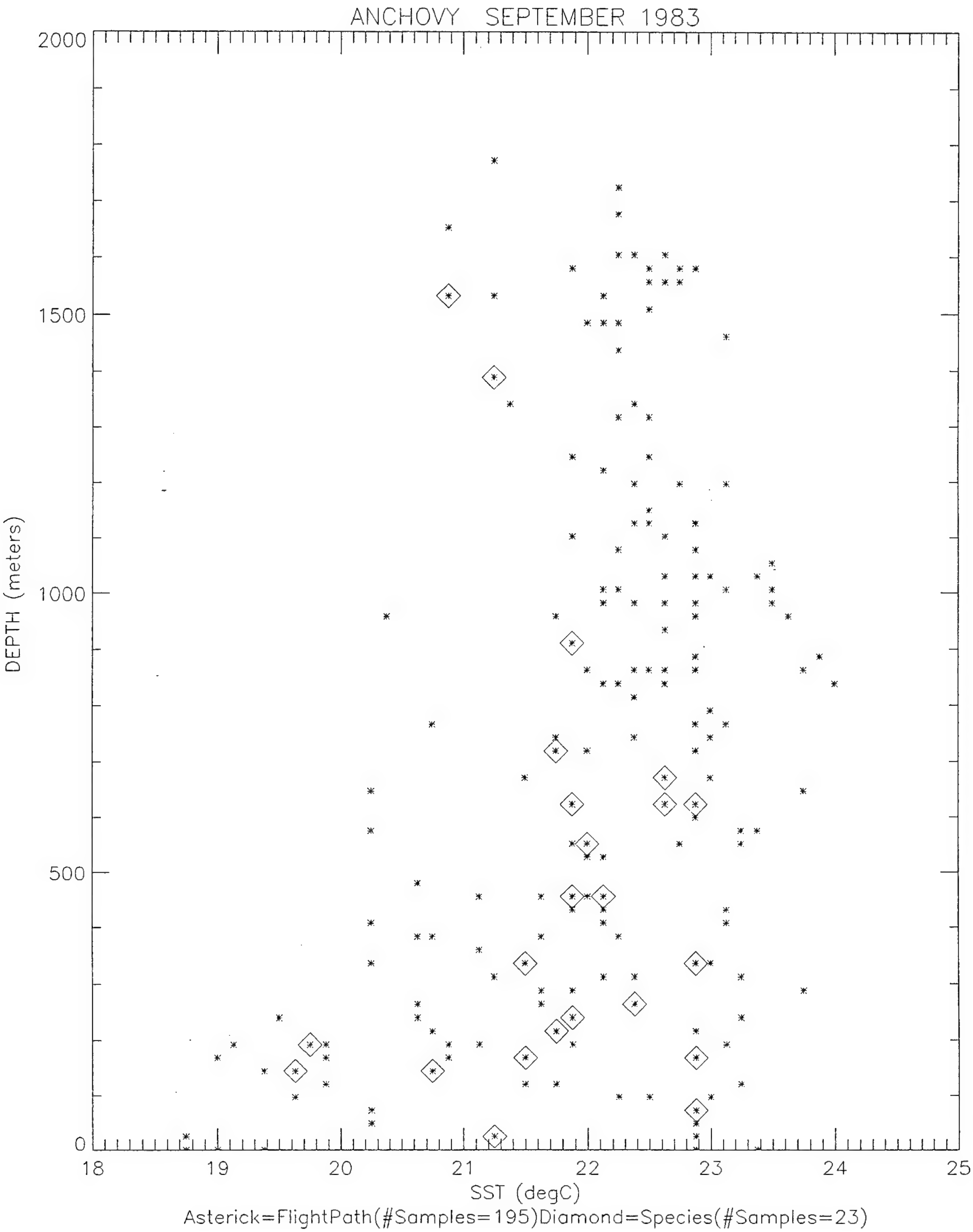

ANCHOVY SEPTEMBER 1983
25
24
23
22
21
20
19
18
SST (degC)
0.01
0.10
1.00
10.00
100.00
LOG[Chlorophyll(mg/m^3)]
Asterick=FlightPath(#Samples=195)Diamond=Species(#Samples=23)

Figure 14



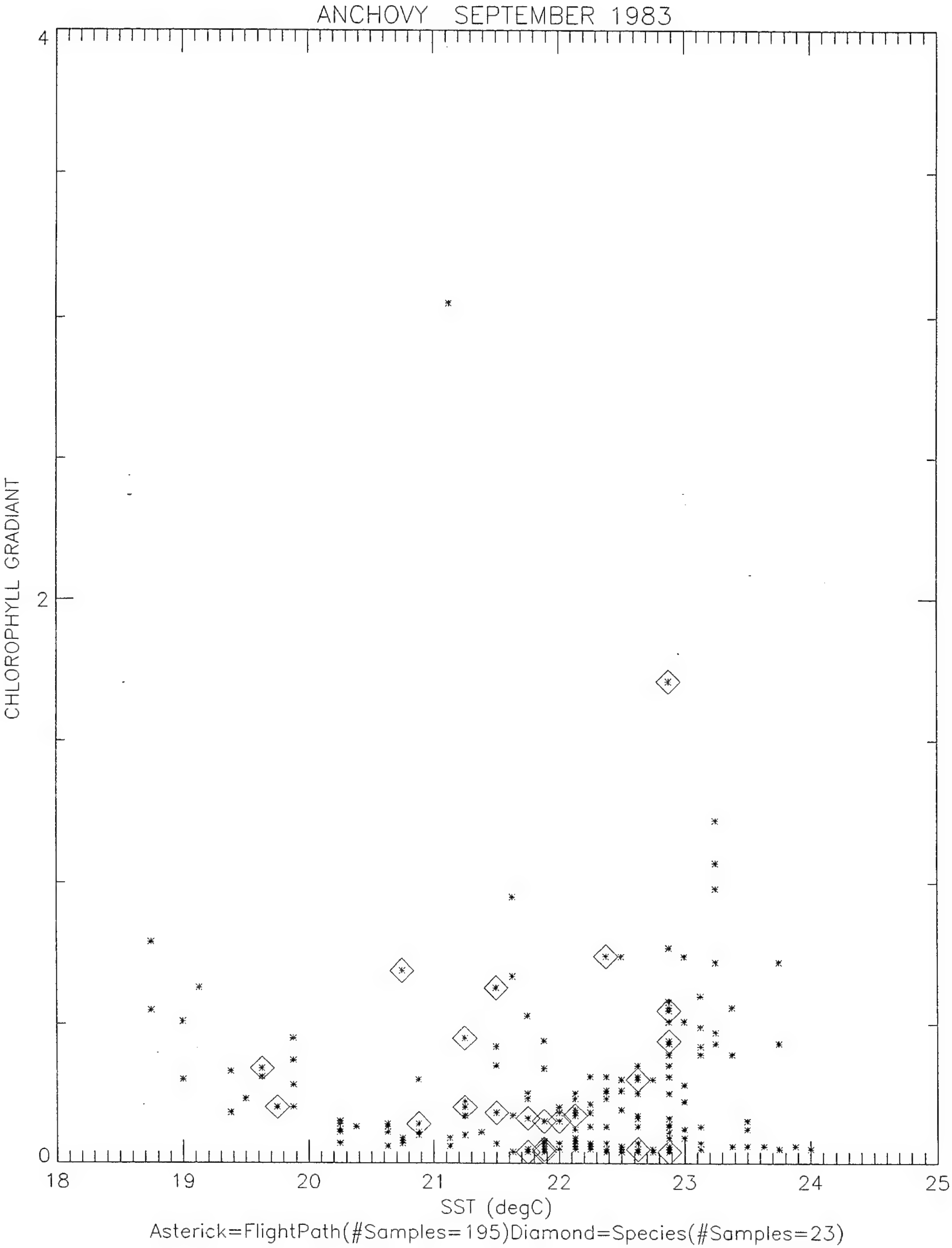
ANCHOVY SEPTEMBER 1983
2000
1500
1000
500
0
DEPTH (meters)
0.01
0.10
1.00
10.00
100.00
LOG[Chlorophyll(mg/m^3)]
Asterick=FlightPath(#Samples=195)Diamond=Species(#Samples=23)

Figure 15



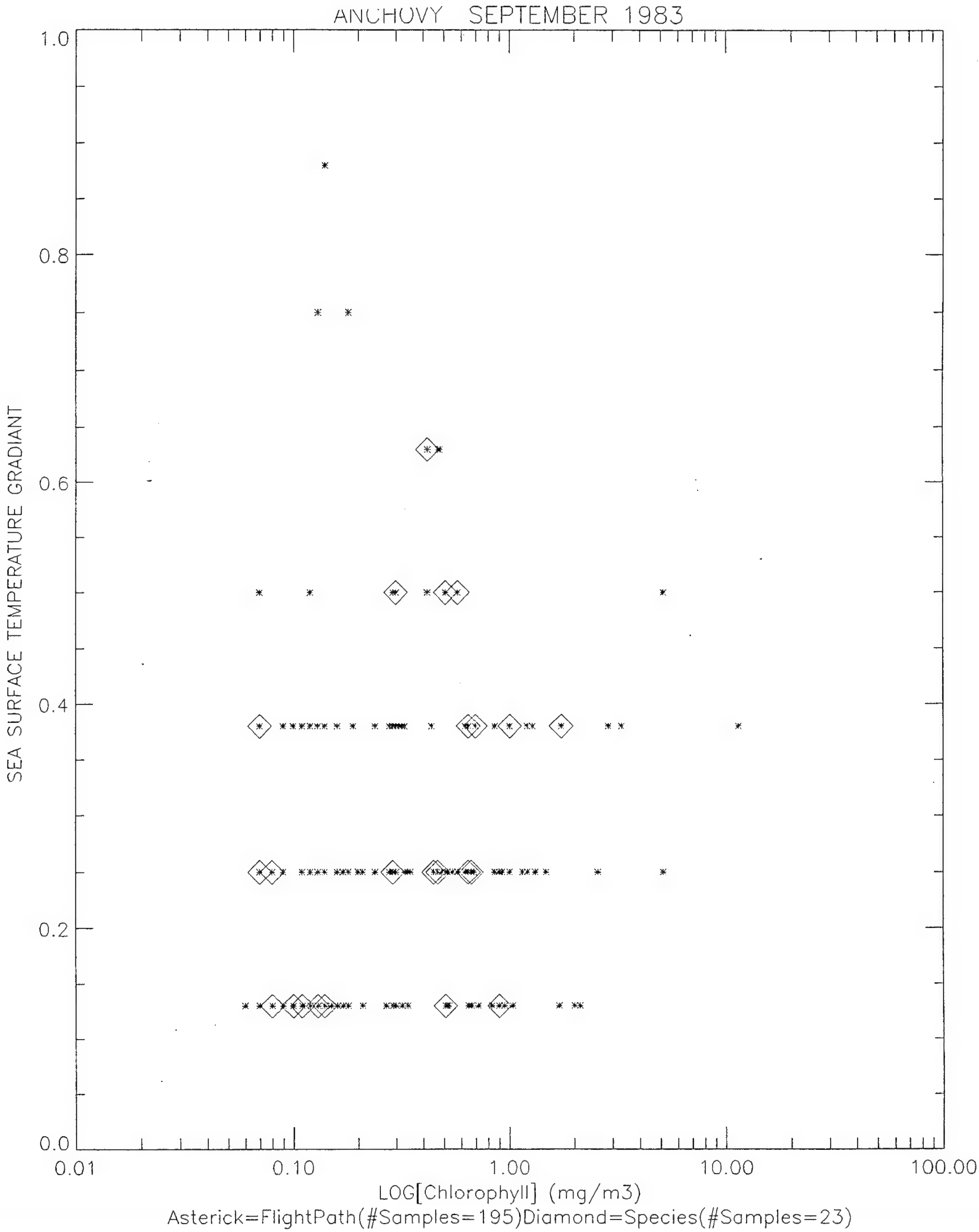
ANCHOVY SEPTEMBER 1983
DEPTH (meters)
2000
1500
1000
500
0
18
19
20
21
22
23
24
25
SST (degC)
Asterick=FlightPath(#Samples=195)Diamond=Species(#Samples=23)

Figure 16



ANCHOVY SEPTEMBER 1983
CHLOROPHYLL GRADIANT
4
2
0
18
19
20
21
22
23
24
25
SST (degC)
Asterick=FlightPath(#Samples=195)Diamond=Species(#Samples=23)

Figure 17



ANCHOVY SEPTEMBER 1983
SEA SURFACE TEMPERATURE GRADIANT
1.0
0.8
0.6
0.4
0.2
0.0
0.01
0.10
1.00
10.00
100.00
LOG[Chlorophyll] (mg/m3)
Asterick=FlightPath(#Samples=195)Diamond=Species(#Samples=23)

Figure 18

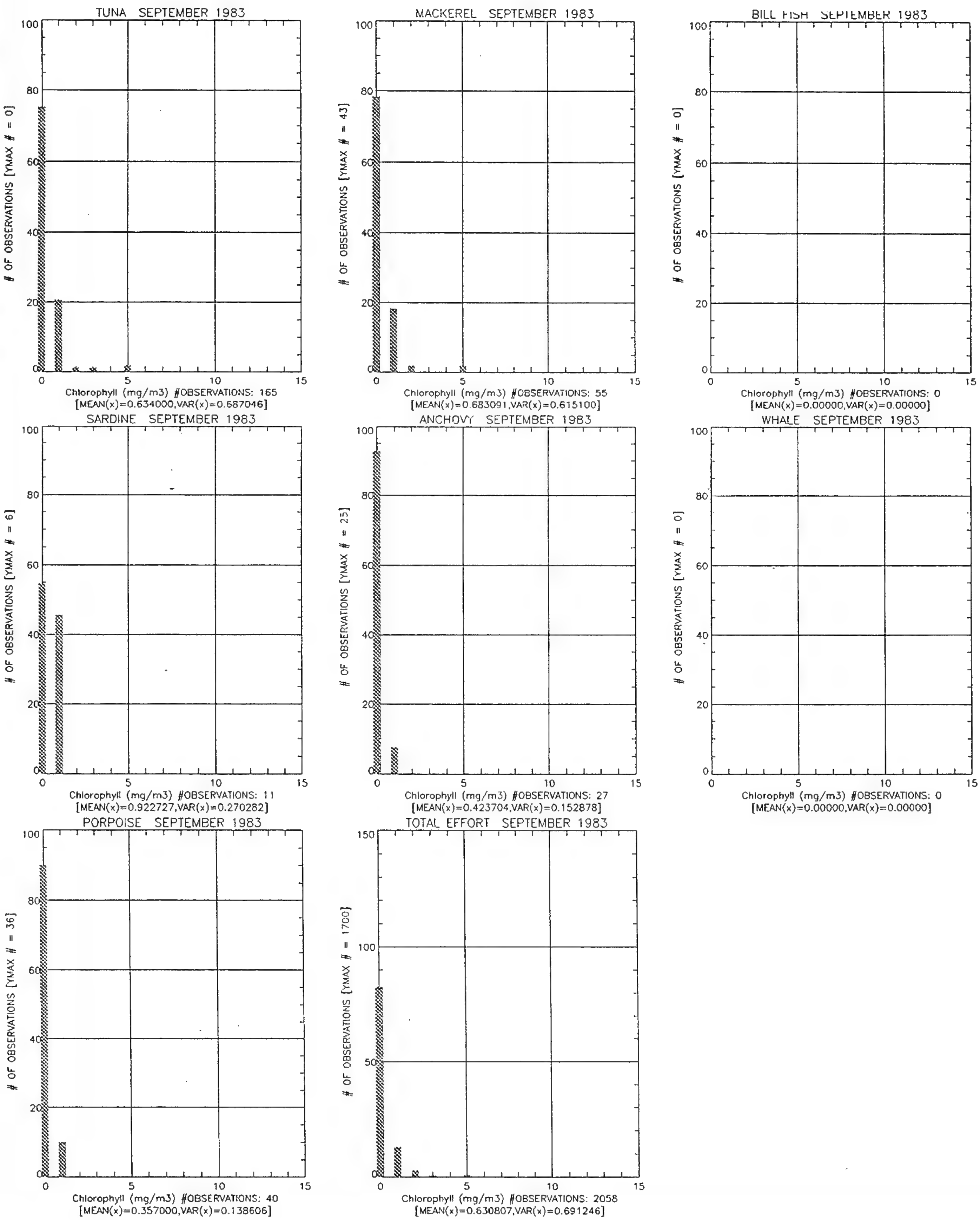

TUNA SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 165
[MEAN(x)=0.634000,VAR(x)=0.687046]
MACKEREL SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 43]
Chlorophyll (mg/m3) #OBSERVATIONS: 55
[MEAN(x)=0.683091,VAR(x)=0.615100]
BILL FISH SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 6]
Chlorophyll (mg/m3) #OBSERVATIONS: 11
[MEAN(x)=0.922727,VAR(x)=0.270282]
ANCHOVY SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 25]
Chlorophyll (mg/m3) #OBSERVATIONS: 27
[MEAN(x)=0.423704,VAR(x)=0.152878]
WHALE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 36]
Chlorophyll (mg/m3) #OBSERVATIONS: 40
[MEAN(x)=0.357000,VAR(x)=0.138606]
TOTAL EFFORT SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 1700]
Chlorophyll (mg/m3) #OBSERVATIONS: 2058
[MEAN(x)=0.630807,VAR(x)=0.691246]

Figure 19

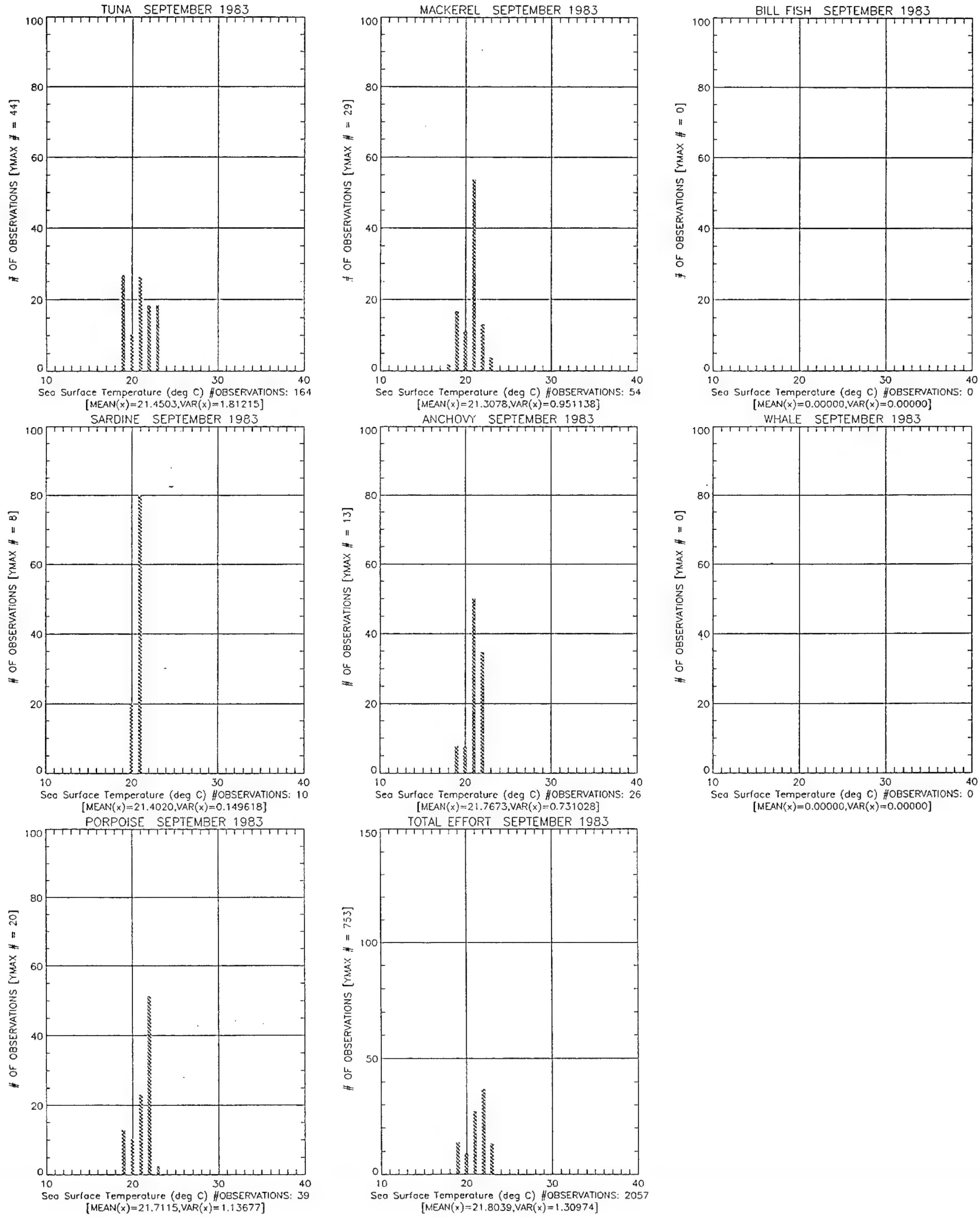
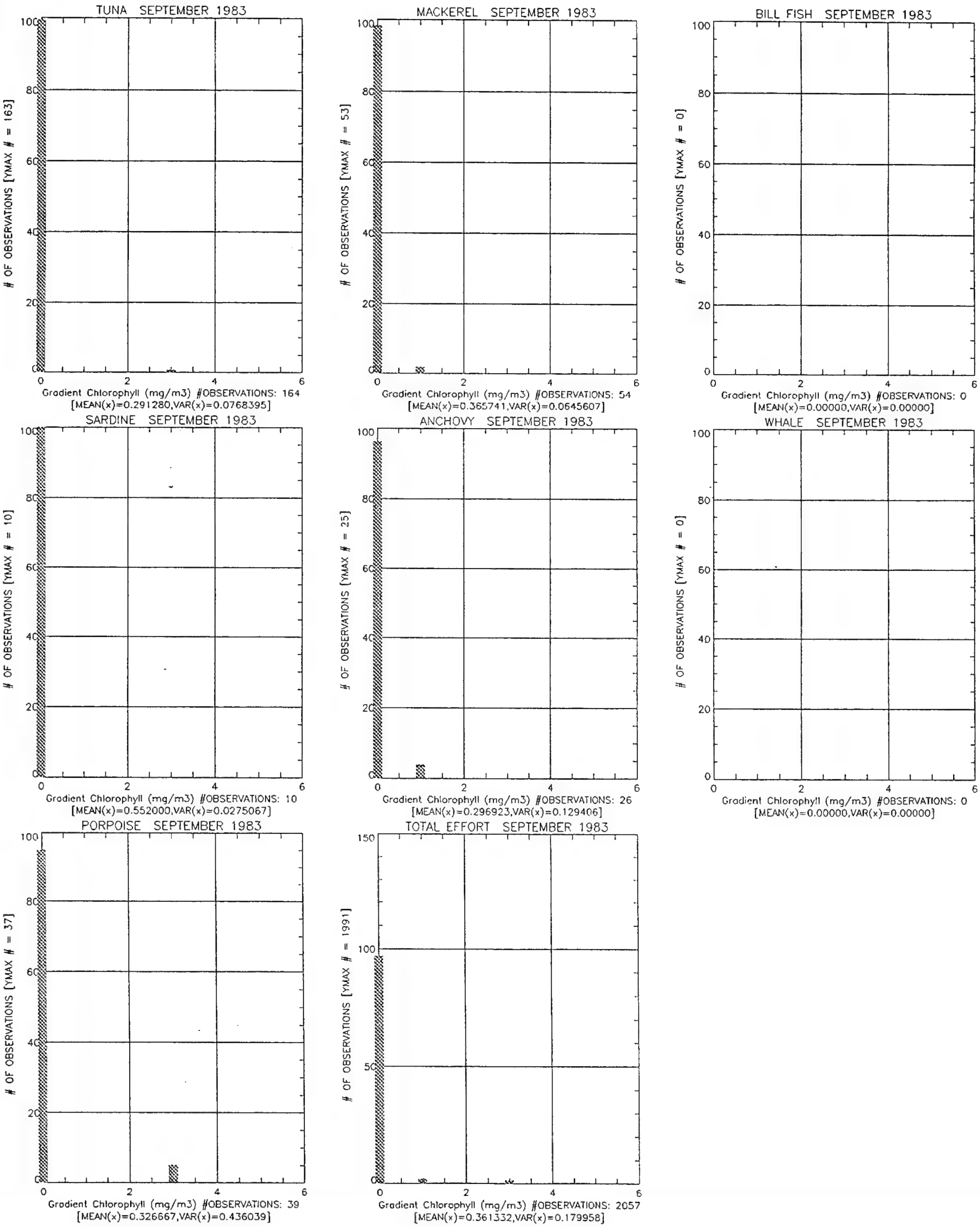

TUNA SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 44]
Sea Surface Temperature (deg C) #OBSERVATIONS: 164
[MEAN(x)=21.4503,VAR(x)=1.81215]
MACKEREL SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 29]
Sea Surface Temperature (deg C) #OBSERVATIONS: 54
[MEAN(x)=21.3078,VAR(x)=0.951138]
BILL FISH SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 8]
Sea Surface Temperature (deg C) #OBSERVATIONS: 10
[MEAN(x)=21.4020,VAR(x)=0.149618]
ANCHOVY SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 13]
Sea Surface Temperature (deg C) #OBSERVATIONS: 26
[MEAN(x)=21.7673,VAR(x)=0.731028]
WHALE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 20]
Sea Surface Temperature (deg C) #OBSERVATIONS: 39
[MEAN(x)=21.7115,VAR(x)=1.13677]
TOTAL EFFORT SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 753]
Sea Surface Temperature (deg C) #OBSERVATIONS: 2057
[MEAN(x)=21.8039,VAR(x)=1.30974]

Figure 20



TUNA SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 163]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 164
[MEAN(x)=0.291280,VAR(x)=0.0768395]
MACKEREL SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 53]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 54
[MEAN(x)=0.365741,VAR(x)=0.0645607]
BILL FISH SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 10]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 10
[MEAN(x)=0.552000,VAR(x)=0.0275067]
ANCHOVY SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 25]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 26
[MEAN(x)=0.296923,VAR(x)=0.129406]
WHALE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 37]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 39
[MEAN(x)=0.326667,VAR(x)=0.436039]
TOTAL EFFORT SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 1991]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 2057
[MEAN(x)=0.361332,VAR(x)=0.179958]

Figure 21

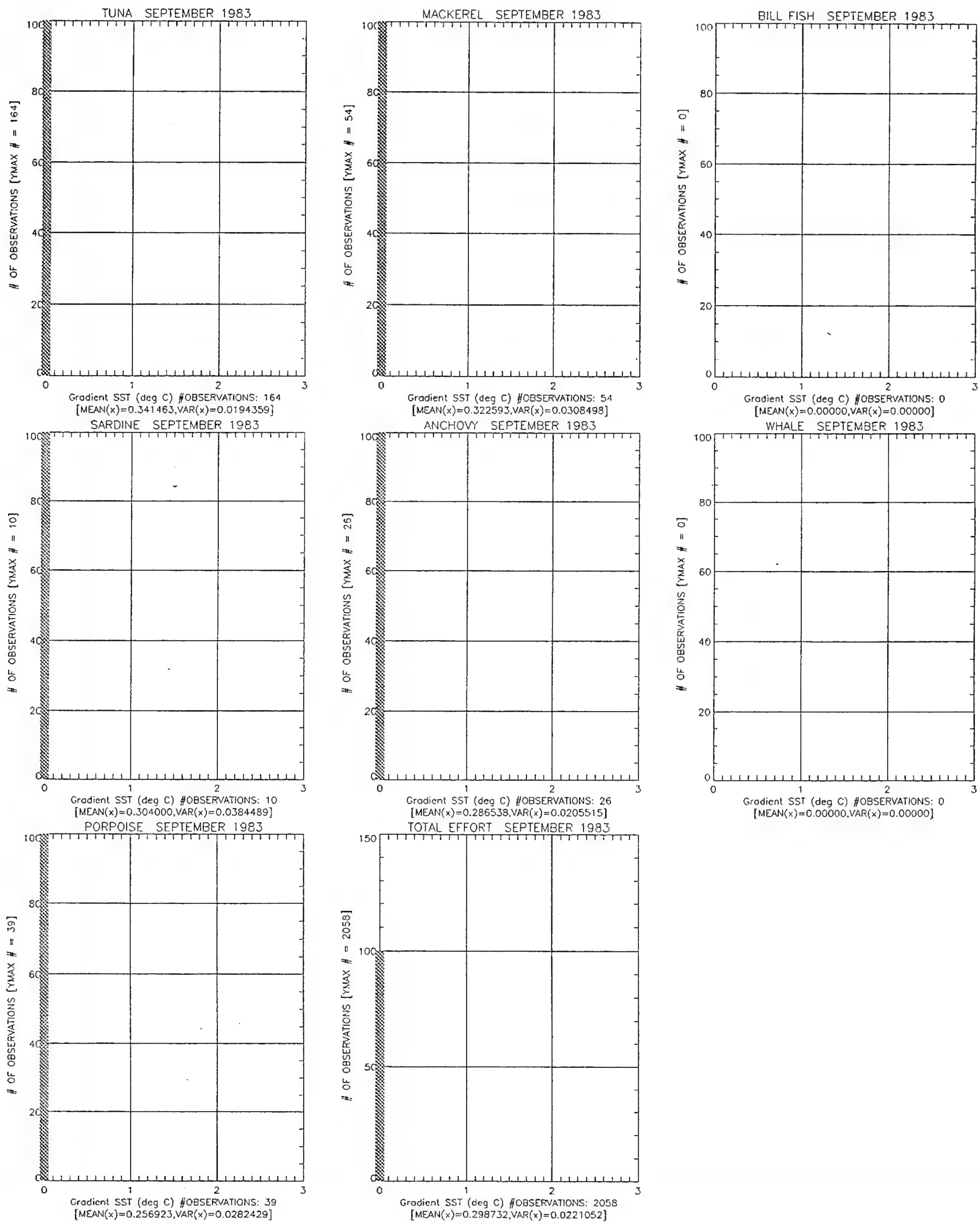

TUNA SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 164]
Gradient SST (deg C) #OBSERVATIONS: 164
[MEAN(x)=0.341463,VAR(x)=0.0194359]
MACKEREL SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 54]
Gradient SST (deg C) #OBSERVATIONS: 54
[MEAN(x)=0.322593,VAR(x)=0.0308498]
BILL FISH SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 10]
Gradient SST (deg C) #OBSERVATIONS: 10
[MEAN(x)=0.304000,VAR(x)=0.0384489]
ANCHOVY SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 25]
Gradient SST (deg C) #OBSERVATIONS: 26
[MEAN(x)=0.286538,VAR(x)=0.0205515]
WHALE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 39]
Gradient SST (deg C) #OBSERVATIONS: 39
[MEAN(x)=0.256923,VAR(x)=0.0282429]
TOTAL EFFORT SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 2058]
Gradient SST (deg C) #OBSERVATIONS: 2058
[MEAN(x)=0.298732,VAR(x)=0.0221052]

Figure 22

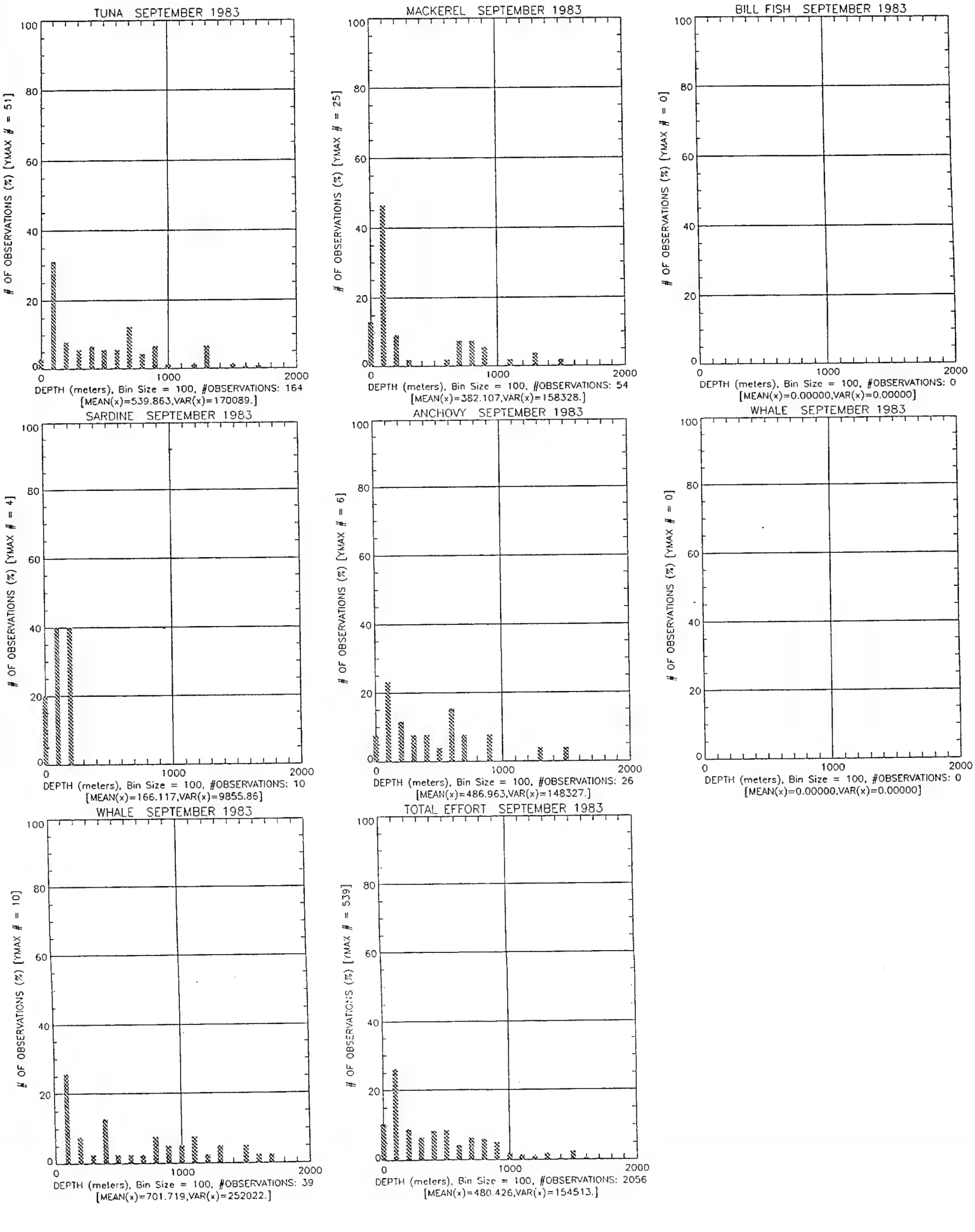

TUNA SEPTEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 51]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 164
[MEAN(x)=539.863,VAR(x)=170089.]
MACKEREL SEPTEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 25]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 54
[MEAN(x)=382.107,VAR(x)=158328.]
BILL FISH SEPTEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE SEPTEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 4]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 10
[MEAN(x)=166.117,VAR(x)=9855.86]
ANCHOVY SEPTEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 6]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 26
[MEAN(x)=486.963,VAR(x)=148327.]
WHALE SEPTEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE SEPTEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 10]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 39
[MEAN(x)=701.719,VAR(x)=252022.]
TOTAL EFFORT SEPTEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 539]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 2056
[MEAN(x)=480.426,VAR(x)=154513.]

Figure 23

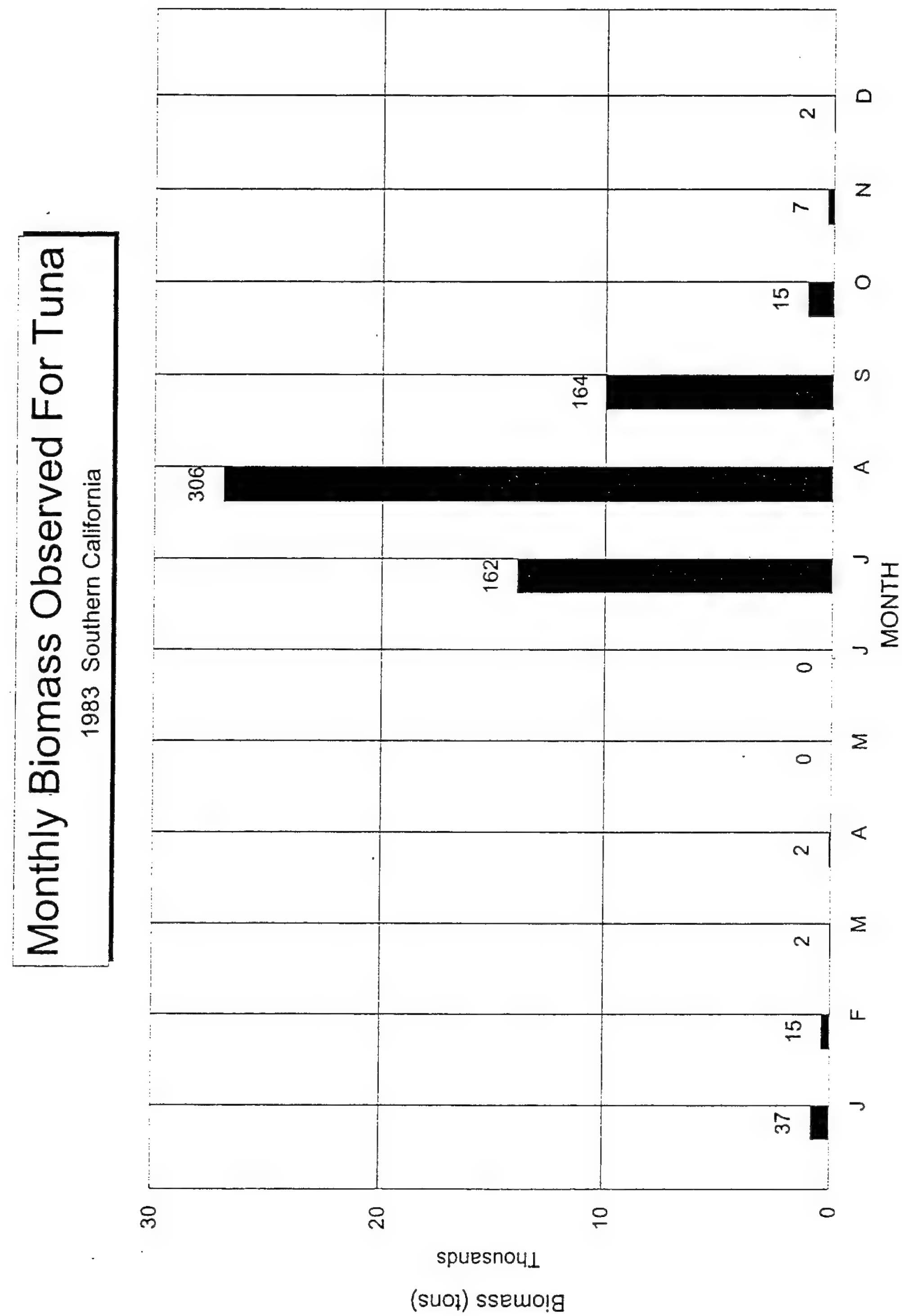
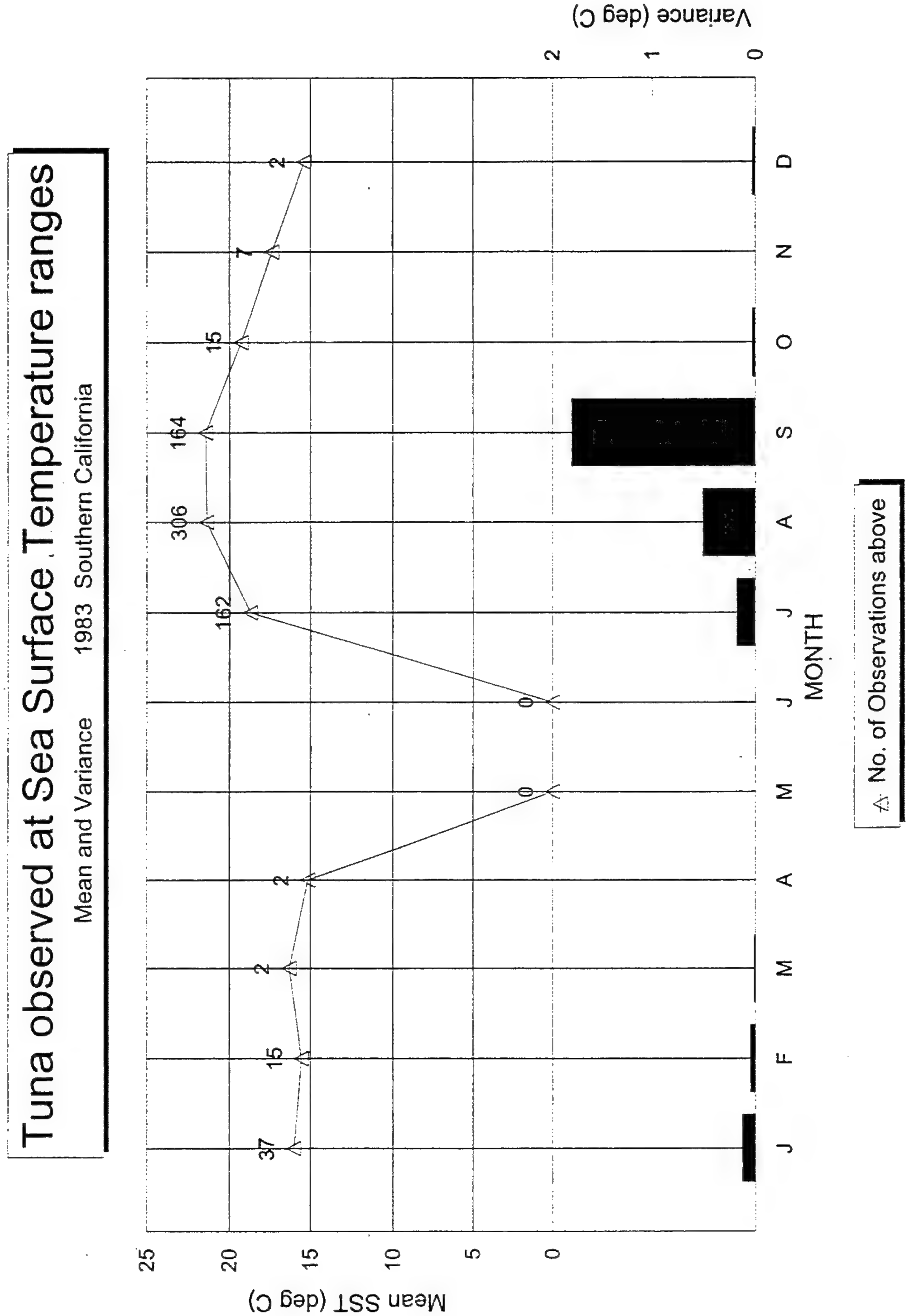

Monthly Biomass Observed For Tuna
1983 Southern California
Biomass (tons)
Thousands
0
10
20
30
37
15
2
2
0
0
162
306
164
15
7
2
J
F
M
A
M
J
J
A
S
O
N
D
MONTH

Figure 24



Tuna observed at Sea Surface Temperature ranges
Mean and Variance 1983 Southern California
Mean SST (deg C)
Variance (deg C)
MONTH
J F M A M J J A S O N D
37 15 2 2 0 0 162 306 164 15 7 2
No. of Observations above

Figure 25

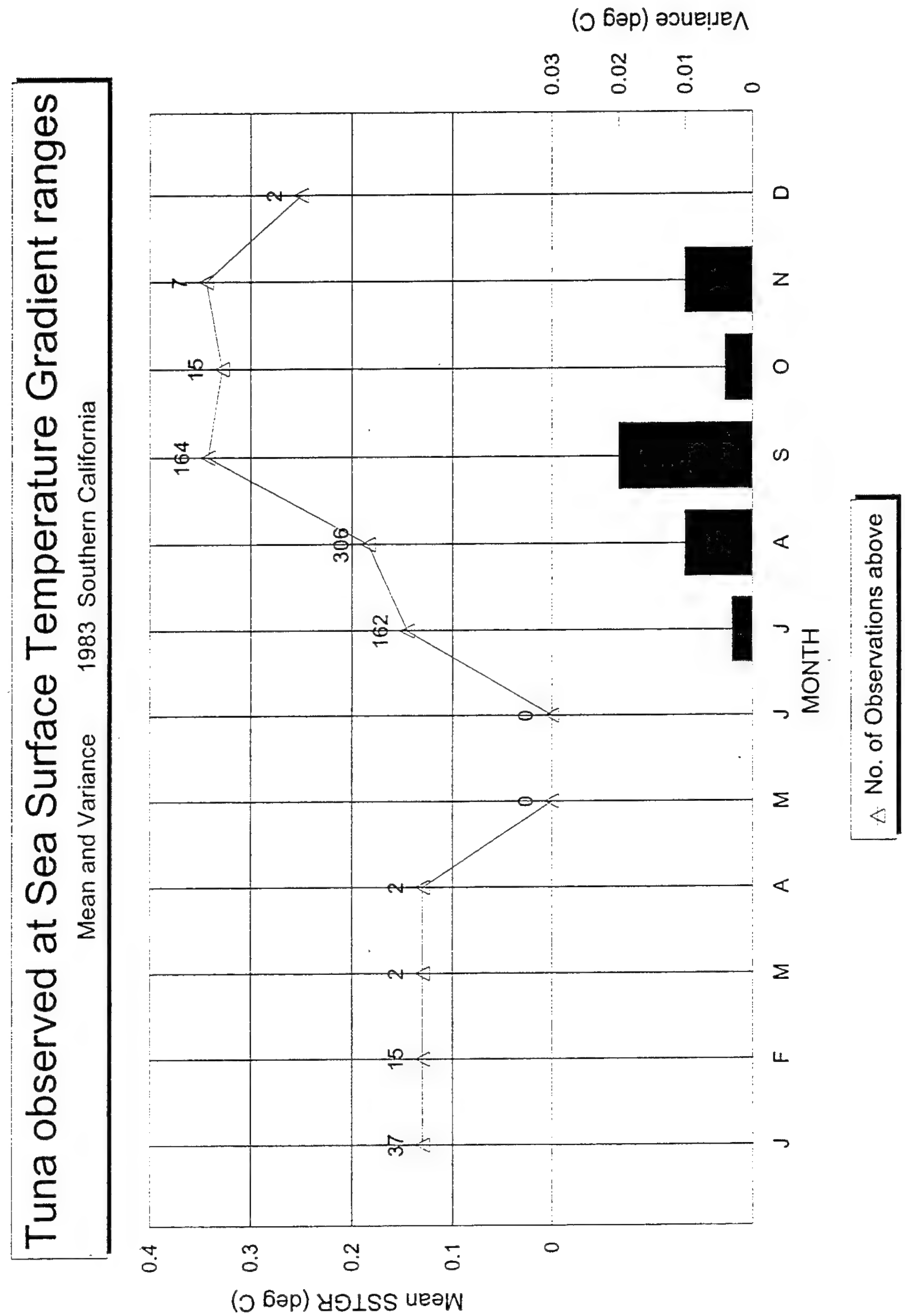
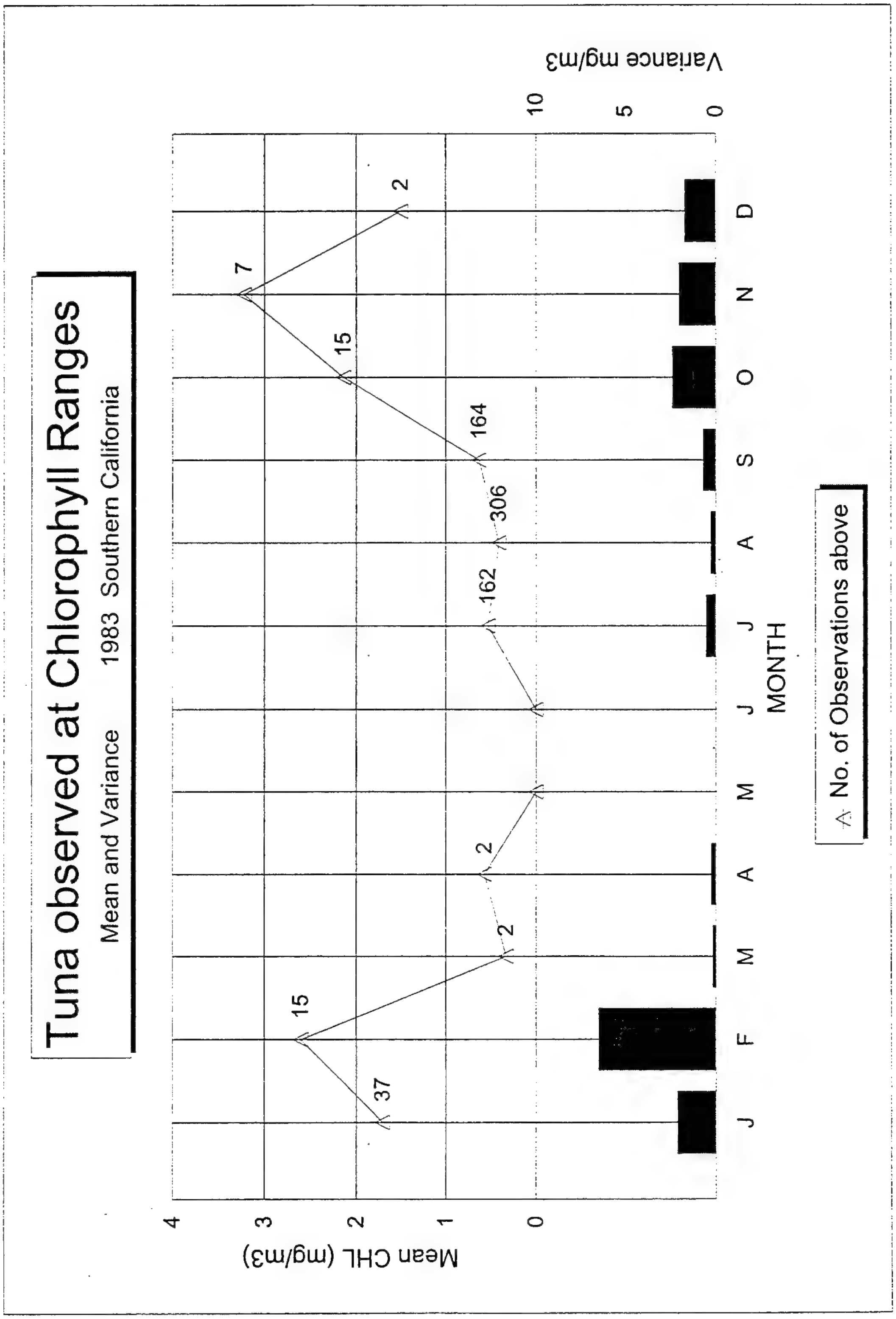

Tuna observed at Sea Surface Temperature Gradient ranges
Mean and Variance
1983 Southern California
Mean SSTGR (deg C)
0.4
0.3
0.2
0.1
0
Variance (deg C)
0.03
0.02
0.01
0
J
F
M
A
M
J
J
A
S
O
N
D
MONTH
37
15
2
2
0
0
162
306
164
15
7
2
No. of Observations above

Figure 26



Tuna observed at Chlorophyll Ranges
Mean and Variance 1983 Southern California
Mean CHL (mg/m3)
Variance mg/m3
MONTH
J F M A M J J A S O N D
37
15
2
2
162
306
164
15
7
2
No. of Observations above

Figure 27

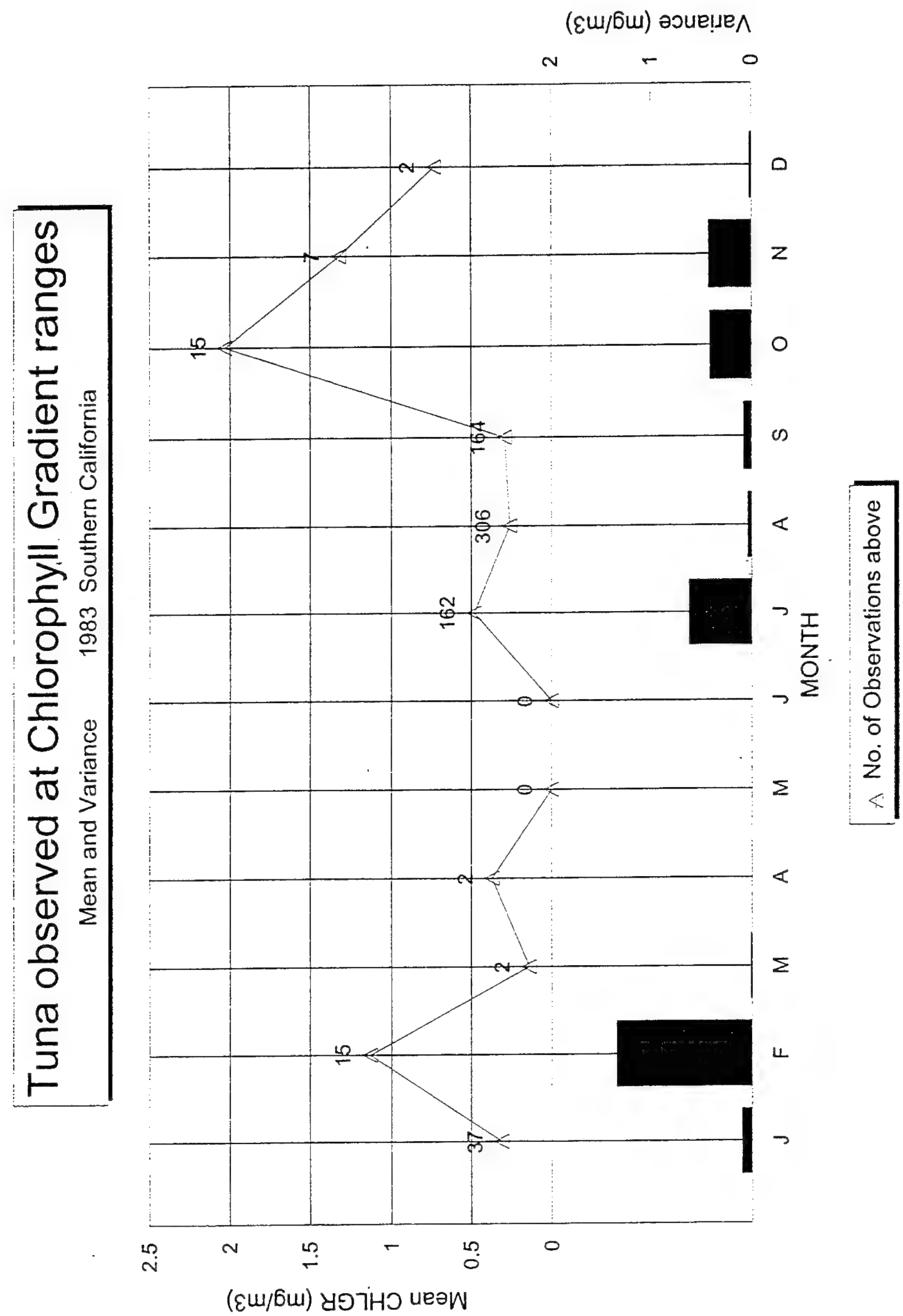
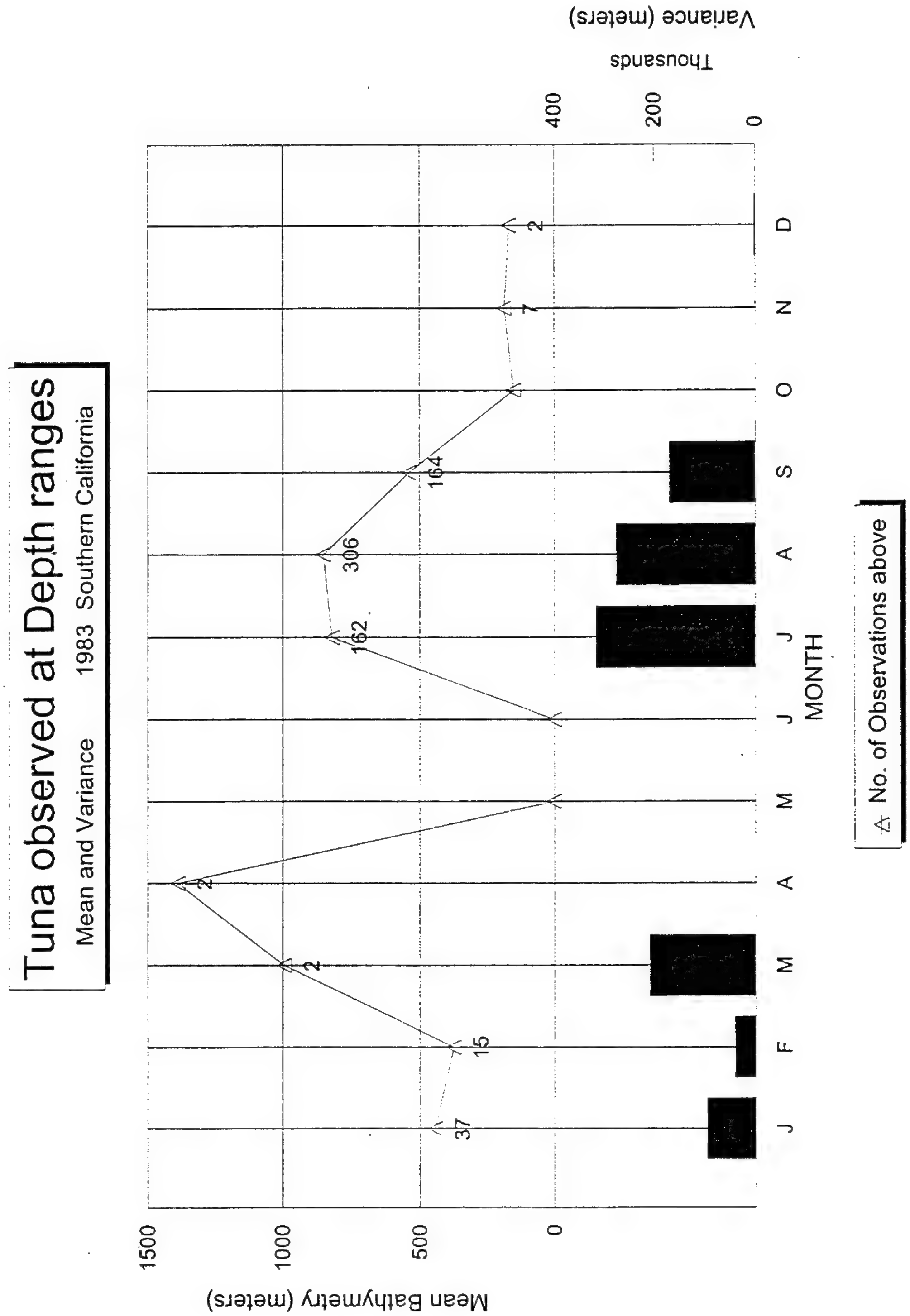
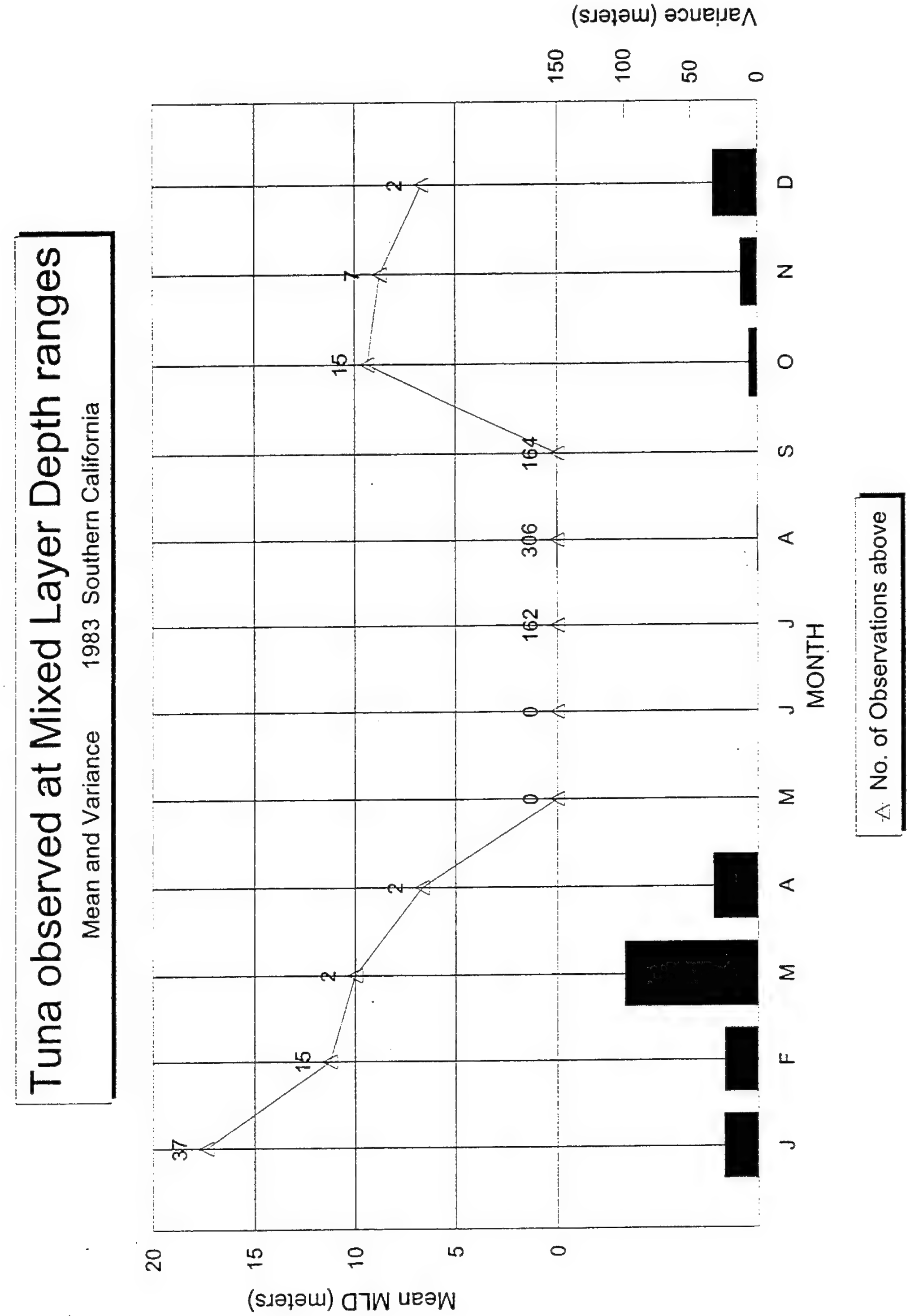

Tuna observed at Chlorophyll Gradient ranges
Mean and Variance 1983 Southern California
Mean CHLGR (mg/m3)
Variance (mg/m3)
MONTH
J F M A M J J A S O N D
No. of Observations above
37
15
2
2
0
0
162
306
164
15
7
2

Figure 28



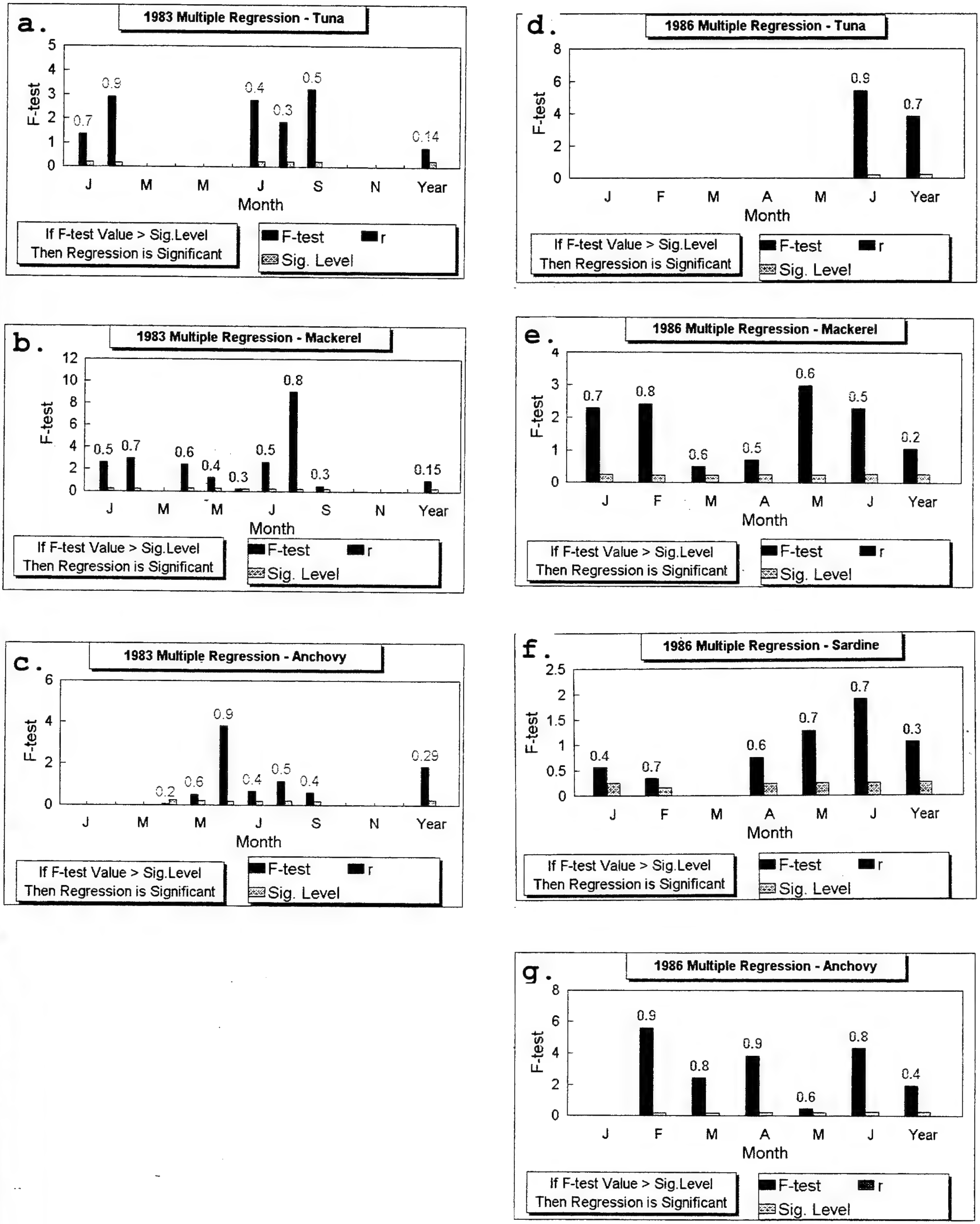
Tuna observed at Depth ranges
Mean and Variance
1983 Southern California
Mean Bathymetry (meters)
1500
1000
500
0
Variance (meters)
Thousands
400
200
0
J
F
M
A
M
J
J
A
S
O
N
D
MONTH
37
15
2
2
162
306
164
7
2
No. of Observations above

Figure 29



Tuna observed at Mixed Layer Depth ranges
Mean and Variance 1983 Southern California
Mean MLD (meters)
20
15
10
5
0
Variance (meters)
150
100
50
0
37
15
2
2
0
0
162
306
164
15
7
2
J
F
M
A
M
J
J
A
S
O
N
D
MONTH
△ No. of Observations above

Figure 30



a.
1983 Multiple Regression - Tuna
F-test
5 4 3 2 1 0
0.7 0.9 0.4 0.3 0.5 0.14
J M M J S N Year
Month
If F-test Value > Sig.Level
Then Regression is Significant
F-test
r
Sig. Level
b.
1983 Multiple Regression - Mackerel
F-test
12 10 8 6 4 2 0
0.5 0.7 0.6 0.4 0.3 0.5 0.8 0.3 0.15
J M M J S N Year
Month
If F-test Value > Sig.Level
Then Regression is Significant
F-test
r
Sig. Level
c.
1983 Multiple Regression - Anchovy
F-test
6 4 2 0
0.2 0.6 0.9 0.4 0.5 0.4 0.29
J M M J S N Year
Month
If F-test Value > Sig.Level
Then Regression is Significant
F-test
r
Sig. Level
d.
1986 Multiple Regression - Tuna
F-test
8 6 4 2 0
0.9 0.7
J F M A M J Year
Month
If F-test Value > Sig.Level
Then Regression is Significant
F-test
r
Sig. Level
e.
1986 Multiple Regression - Mackerel
F-test
4 3 2 1 0
0.7 0.8 0.6 0.5 0.6 0.5 0.2
J F M A M J Year
Month
If F-test Value > Sig.Level
Then Regression is Significant
F-test
r
Sig. Level
f.
1986 Multiple Regression - Sardine
F-test
2.5 2 1.5 1 0.5 0
0.4 0.7 0.6 0.7 0.7 0.3
J F M A M J Year
Month
If F-test Value > Sig.Level
Then Regression is Significant
F-test
r
Sig. Level
g.
1986 Multiple Regression - Anchovy
F-test
8 6 4 2 0
0.9 0.8 0.9 0.6 0.8 0.4
J F M A M J Year
Month
If F-test Value > Sig.Level
Then Regression is Significant
F-test
r
Sig. Level

Figure 31

Appendix A

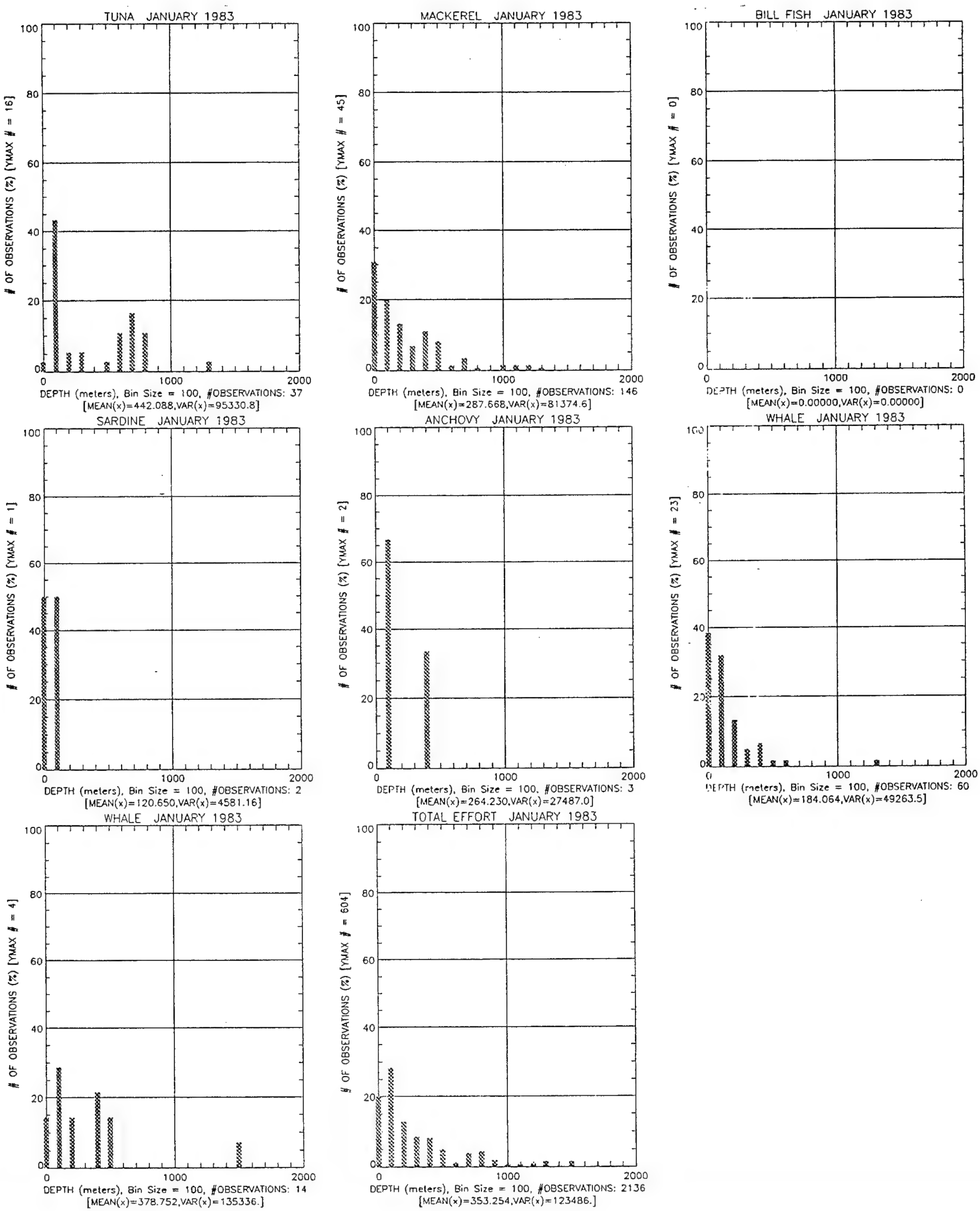
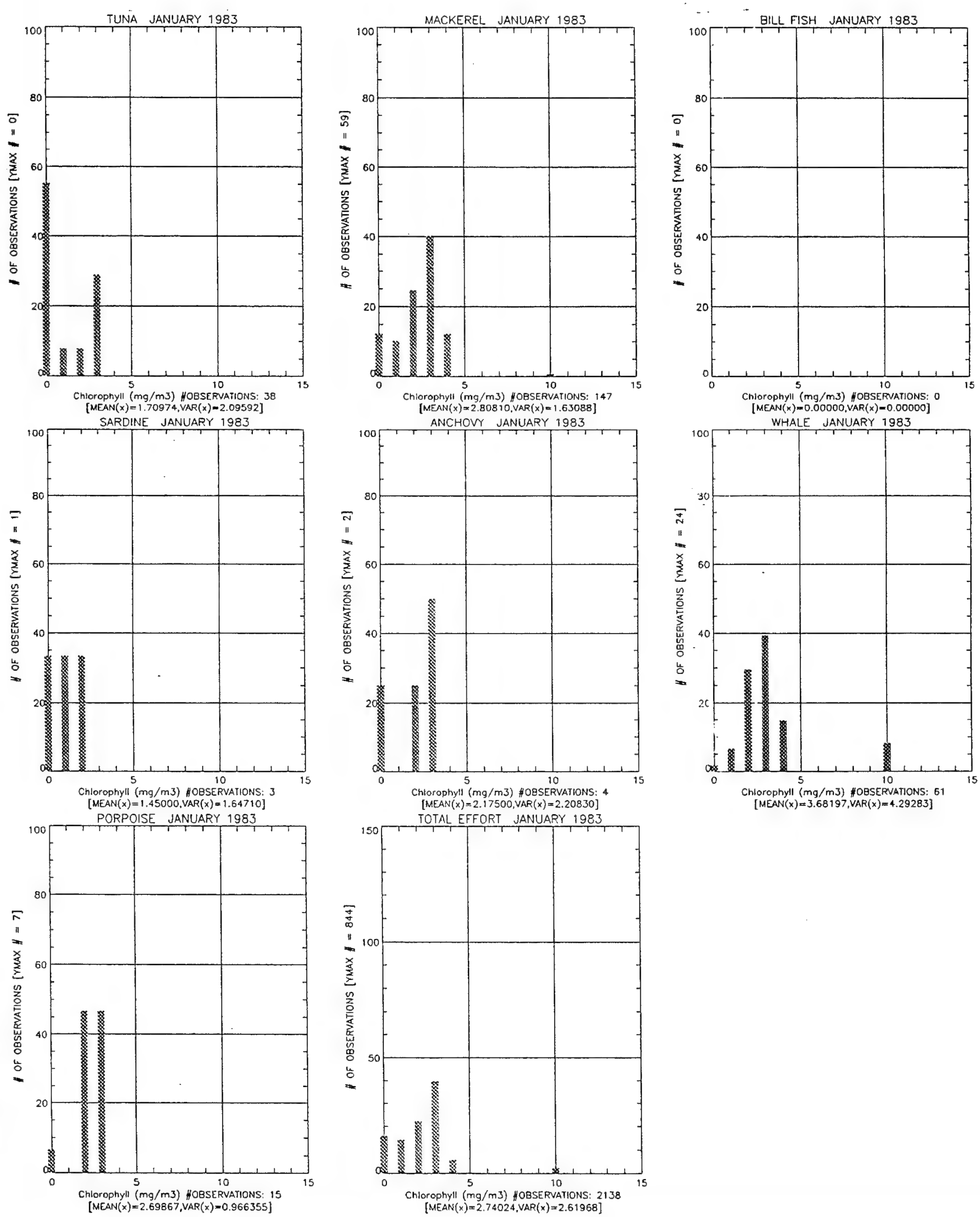


Figure 32



TUNA JANUARY 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 38
[MEAN(x)=1.70974,VAR(x)=2.09592]
MACKEREL JANUARY 1983
OF OBSERVATIONS [YMAX # = 59]
Chlorophyll (mg/m3) #OBSERVATIONS: 147
[MEAN(x)=2.80810,VAR(x)=1.63088]
BILL FISH JANUARY 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE JANUARY 1983
OF OBSERVATIONS [YMAX # = 1]
Chlorophyll (mg/m3) #OBSERVATIONS: 3
[MEAN(x)=1.45000,VAR(x)=1.64710]
ANCHOVY JANUARY 1983
OF OBSERVATIONS [YMAX # = 2]
Chlorophyll (mg/m3) #OBSERVATIONS: 4
[MEAN(x)=2.17500,VAR(x)=2.20830]
WHALE JANUARY 1983
OF OBSERVATIONS [YMAX # = 24]
Chlorophyll (mg/m3) #OBSERVATIONS: 61
[MEAN(x)=3.68197,VAR(x)=4.29283]
PORPOISE JANUARY 1983
OF OBSERVATIONS [YMAX # = 7]
Chlorophyll (mg/m3) #OBSERVATIONS: 15
[MEAN(x)=2.69867,VAR(x)=0.966355]
TOTAL EFFORT JANUARY 1983
OF OBSERVATIONS [YMAX # = 844]
Chlorophyll (mg/m3) #OBSERVATIONS: 2138
[MEAN(x)=2.74024,VAR(x)=2.61968]

Figure 33

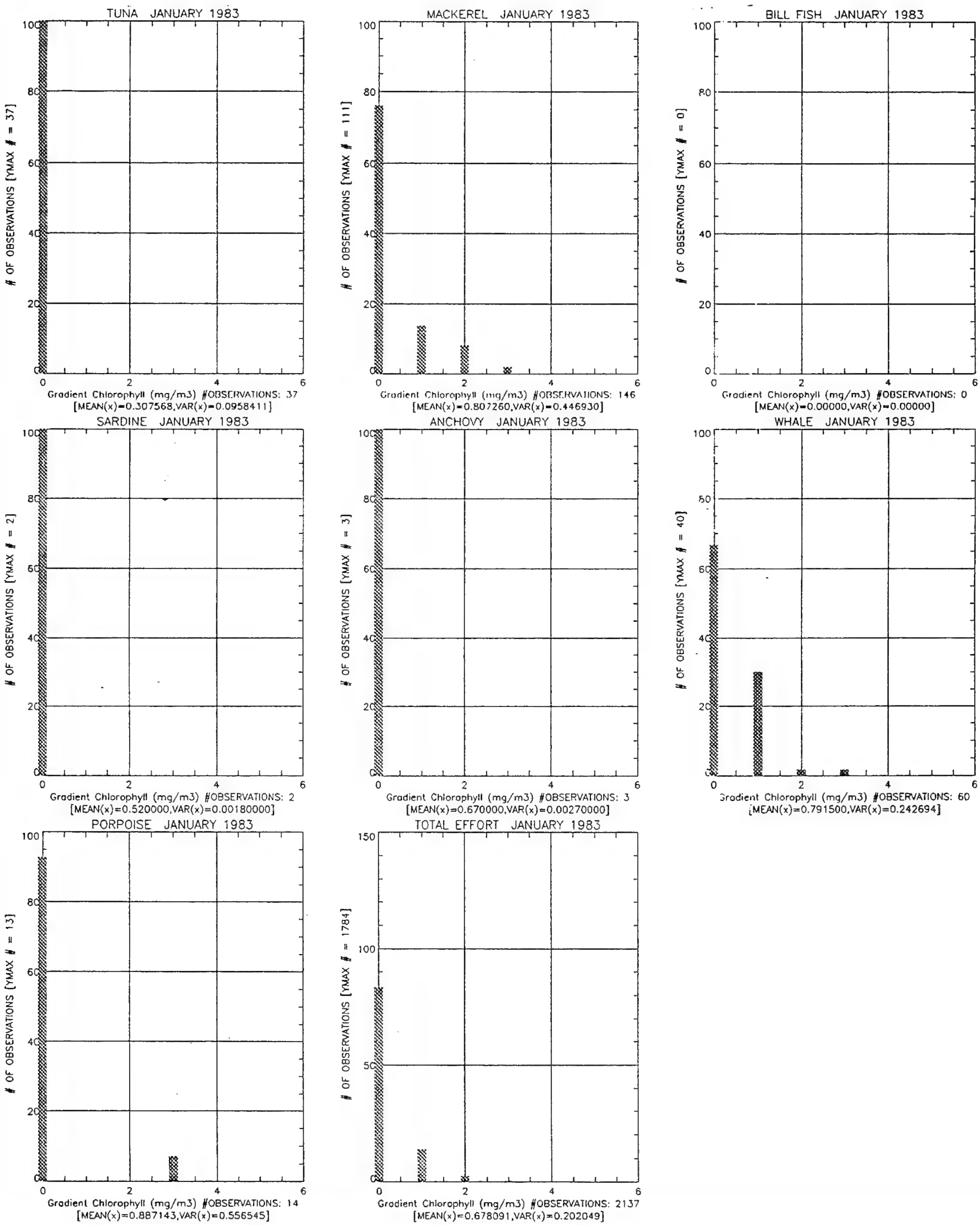
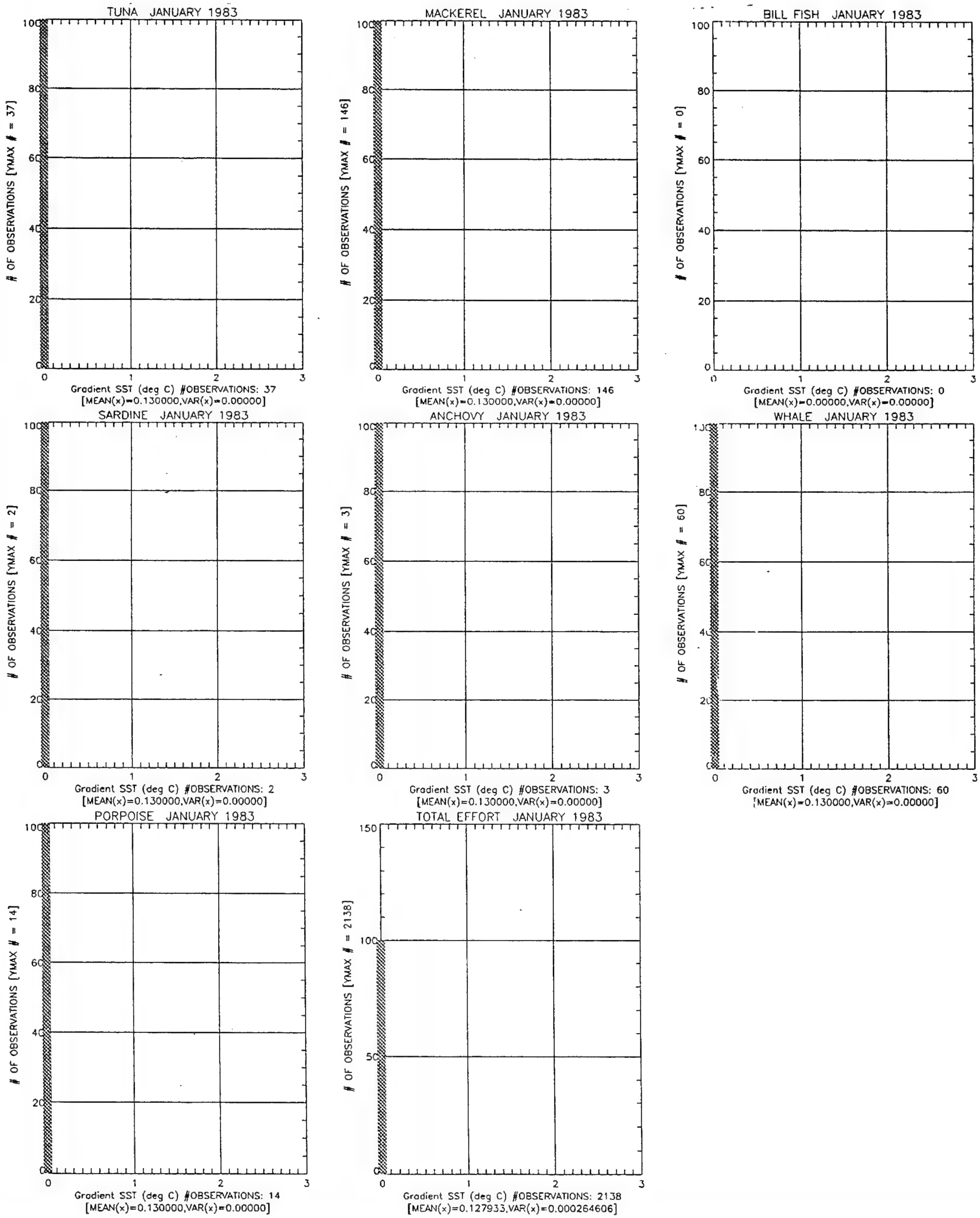

TUNA JANUARY 1983
OF OBSERVATIONS [YMAX # = 37]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 37
[MEAN(x)=0.307568,VAR(x)=0.0958411]
MACKEREL JANUARY 1983
OF OBSERVATIONS [YMAX # = 111]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 146
[MEAN(x)=0.807260,VAR(x)=0.446930]
BILL FISH JANUARY 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE JANUARY 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 2
[MEAN(x)=0.520000,VAR(x)=0.00180000]
ANCHOVY JANUARY 1983
OF OBSERVATIONS [YMAX # = 3]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 3
[MEAN(x)=0.670000,VAR(x)=0.00270000]
WHALE JANUARY 1983
OF OBSERVATIONS [YMAX # = 40]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 60
[MEAN(x)=0.791500,VAR(x)=0.242694]
PORPOISE JANUARY 1983
OF OBSERVATIONS [YMAX # = 13]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 14
[MEAN(x)=0.887143,VAR(x)=0.556545]
TOTAL EFFORT JANUARY 1983
OF OBSERVATIONS [YMAX # = 1784]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 2137
[MEAN(x)=0.678091,VAR(x)=0.202049]

Figure 34



TUNA JANUARY 1983
OF OBSERVATIONS [YMAX # = 37]
Gradient SST (deg C) #OBSERVATIONS: 37
[MEAN(x)=0.130000,VAR(x)=0.00000]
MACKEREL JANUARY 1983
OF OBSERVATIONS [YMAX # = 146]
Gradient SST (deg C) #OBSERVATIONS: 146
[MEAN(x)=0.130000,VAR(x)=0.00000]
BILL FISH JANUARY 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE JANUARY 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient SST (deg C) #OBSERVATIONS: 2
[MEAN(x)=0.130000,VAR(x)=0.00000]
ANCHOVY JANUARY 1983
OF OBSERVATIONS [YMAX # = 3]
Gradient SST (deg C) #OBSERVATIONS: 3
[MEAN(x)=0.130000,VAR(x)=0.00000]
WHALE JANUARY 1983
OF OBSERVATIONS [YMAX # = 60]
Gradient SST (deg C) #OBSERVATIONS: 60
[MEAN(x)=0.130000,VAR(x)=0.00000]
PORPOISE JANUARY 1983
OF OBSERVATIONS [YMAX # = 14]
Gradient SST (deg C) #OBSERVATIONS: 14
[MEAN(x)=0.130000,VAR(x)=0.00000]
TOTAL EFFORT JANUARY 1983
OF OBSERVATIONS [YMAX # = 2138]
Gradient SST (deg C) #OBSERVATIONS: 2138
[MEAN(x)=0.127933,VAR(x)=0.000264606]

Figure 35

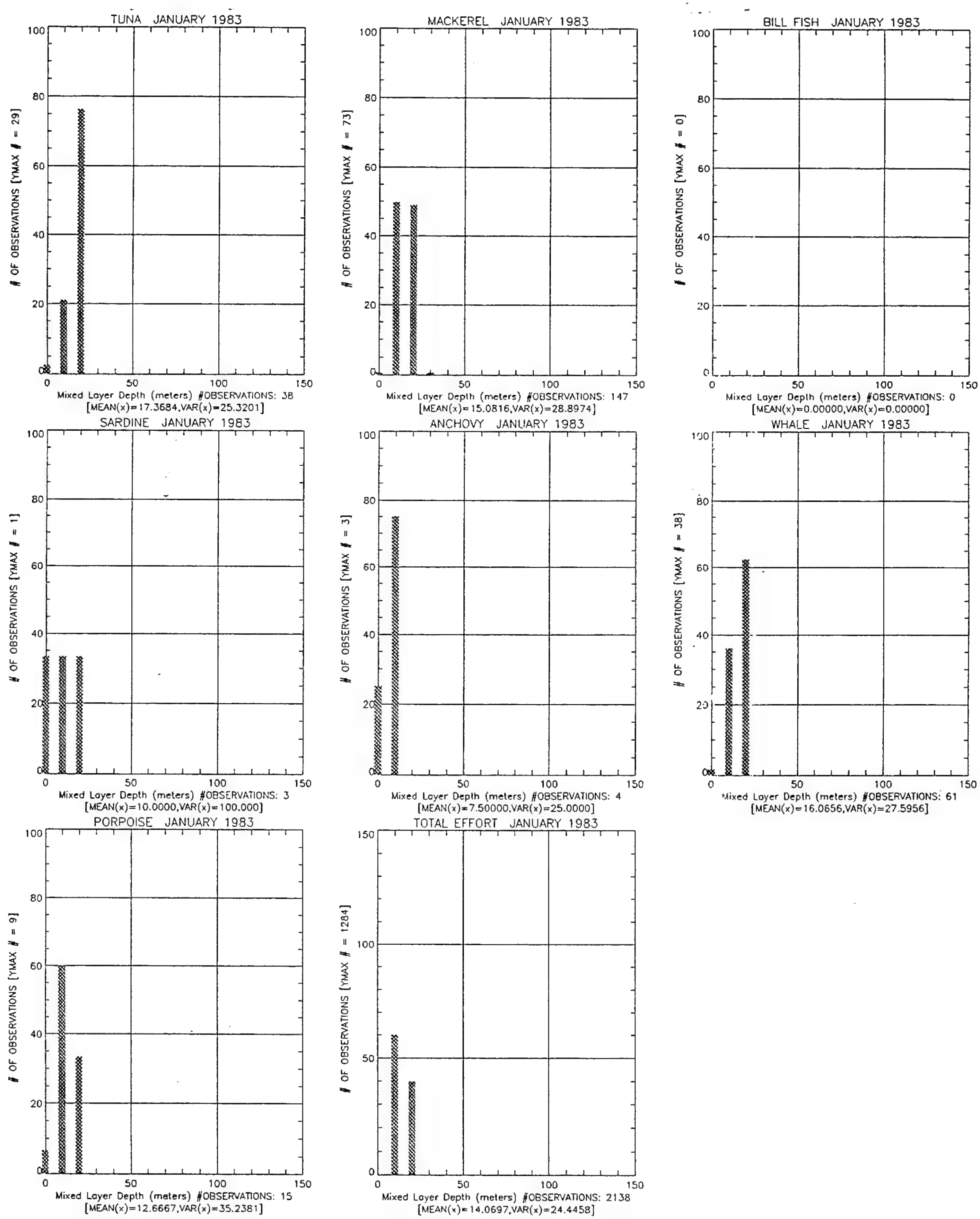

TUNA JANUARY 1983
OF OBSERVATIONS [YMAX # = 29]
Mixed Layer Depth (meters) #OBSERVATIONS: 38
[MEAN(x)=17.3684,VAR(x)=25.3201]
MACKEREL JANUARY 1983
OF OBSERVATIONS [YMAX # = 73]
Mixed Layer Depth (meters) #OBSERVATIONS: 147
[MEAN(x)=15.0816,VAR(x)=28.8974]
BILL FISH JANUARY 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE JANUARY 1983
OF OBSERVATIONS [YMAX # = 1]
Mixed Layer Depth (meters) #OBSERVATIONS: 3
[MEAN(x)=10.0000,VAR(x)=100.000]
ANCHOVY JANUARY 1983
OF OBSERVATIONS [YMAX # = 3]
Mixed Layer Depth (meters) #OBSERVATIONS: 4
[MEAN(x)=7.50000,VAR(x)=25.0000]
WHALE JANUARY 1983
OF OBSERVATIONS [YMAX # = 38]
Mixed Layer Depth (meters) #OBSERVATIONS: 61
[MEAN(x)=16.0656,VAR(x)=27.5956]
PORPOISE JANUARY 1983
OF OBSERVATIONS [YMAX # = 9]
Mixed Layer Depth (meters) #OBSERVATIONS: 15
[MEAN(x)=12.6667,VAR(x)=35.2381]
TOTAL EFFORT JANUARY 1983
OF OBSERVATIONS [YMAX # = 1284]
Mixed Layer Depth (meters) #OBSERVATIONS: 2138
[MEAN(x)=14.0697,VAR(x)=24.4458]

Figure 36

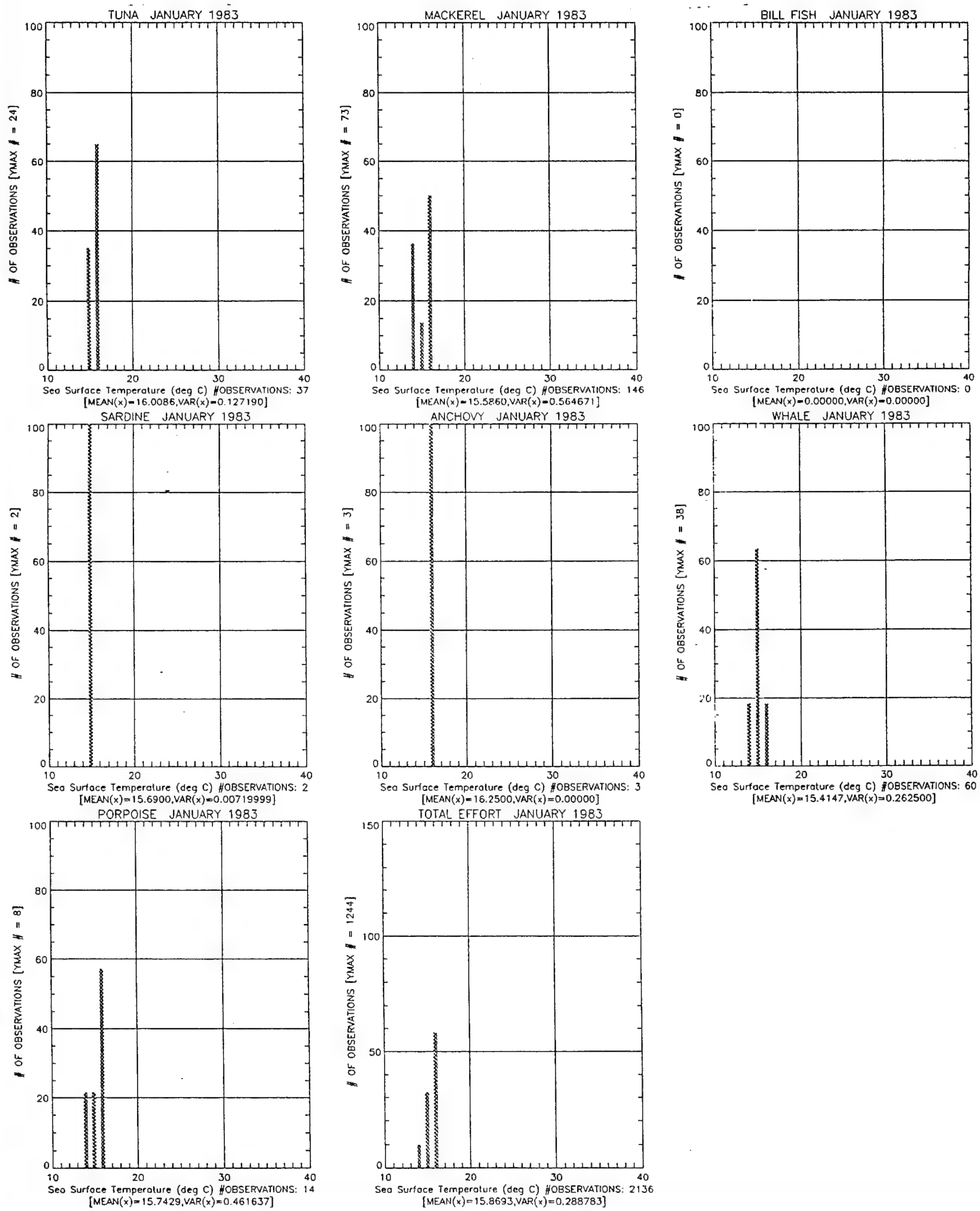
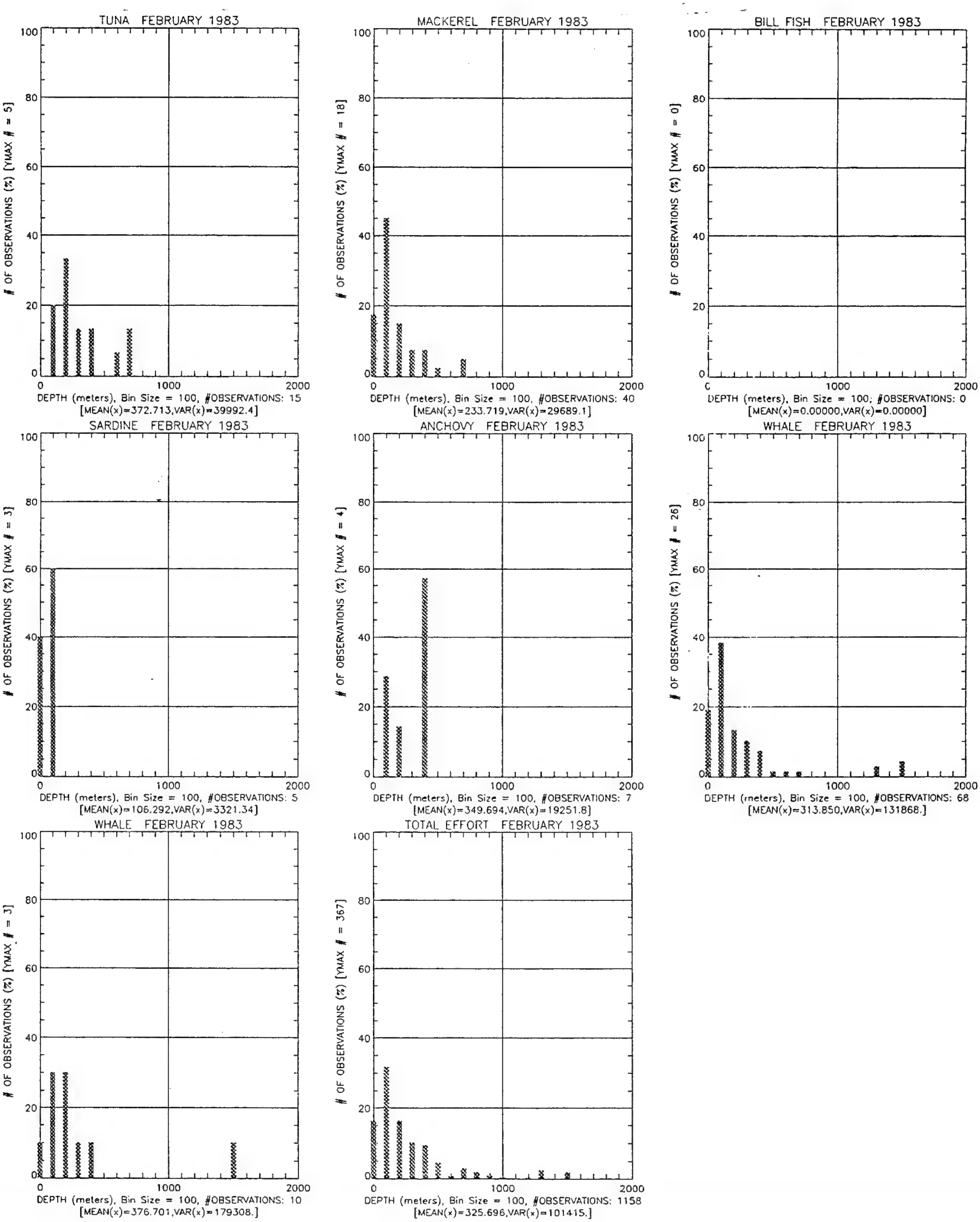

TUNA JANUARY 1983
OF OBSERVATIONS [YMAX # = 24]
Sea Surface Temperature (deg C) #OBSERVATIONS: 37
[MEAN(x)=16.0086,VAR(x)=0.127190]
MACKEREL JANUARY 1983
OF OBSERVATIONS [YMAX # = 73]
Sea Surface Temperature (deg C) #OBSERVATIONS: 146
[MEAN(x)=15.5860,VAR(x)=0.564671]
BILL FISH JANUARY 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE JANUARY 1983
OF OBSERVATIONS [YMAX # = 2]
Sea Surface Temperature (deg C) #OBSERVATIONS: 2
[MEAN(x)=15.6900,VAR(x)=0.00719999]
ANCHOVY JANUARY 1983
OF OBSERVATIONS [YMAX # = 3]
Sea Surface Temperature (deg C) #OBSERVATIONS: 3
[MEAN(x)=16.2500,VAR(x)=0.00000]
WHALE JANUARY 1983
OF OBSERVATIONS [YMAX # = 38]
Sea Surface Temperature (deg C) #OBSERVATIONS: 60
[MEAN(x)=15.4147,VAR(x)=0.262500]
PORPOISE JANUARY 1983
OF OBSERVATIONS [YMAX # = 8]
Sea Surface Temperature (deg C) #OBSERVATIONS: 14
[MEAN(x)=15.7429,VAR(x)=0.461637]
TOTAL EFFORT JANUARY 1983
OF OBSERVATIONS [YMAX # = 1244]
Sea Surface Temperature (deg C) #OBSERVATIONS: 2136
[MEAN(x)=15.8693,VAR(x)=0.288783]

Figure 37



TUNA FEBRUARY 1983
OF OBSERVATIONS (%) [YMAX # = 5]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 15
[MEAN(x)=372.713,VAR(x)=39992.4]
MACKEREL FEBRUARY 1983
OF OBSERVATIONS (%) [YMAX # = 18]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 40
[MEAN(x)=233.719,VAR(x)=29689.1]
BILL FISH FEBRUARY 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE FEBRUARY 1983
OF OBSERVATIONS (%) [YMAX # = 3]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 5
[MEAN(x)=106.292,VAR(x)=3321.34]
ANCHOVY FEBRUARY 1983
OF OBSERVATIONS (%) [YMAX # = 4]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 7
[MEAN(x)=349.694,VAR(x)=19251.8]
WHALE FEBRUARY 1983
OF OBSERVATIONS (%) [YMAX # = 26]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 68
[MEAN(x)=313.850,VAR(x)=131868.]
WHALE FEBRUARY 1983
OF OBSERVATIONS (%) [YMAX # = 3]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 10
[MEAN(x)=376.701,VAR(x)=179308.]
TOTAL EFFORT FEBRUARY 1983
OF OBSERVATIONS (%) [YMAX # = 367]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 1158
[MEAN(x)=325.696,VAR(x)=101415.]

Figure 38

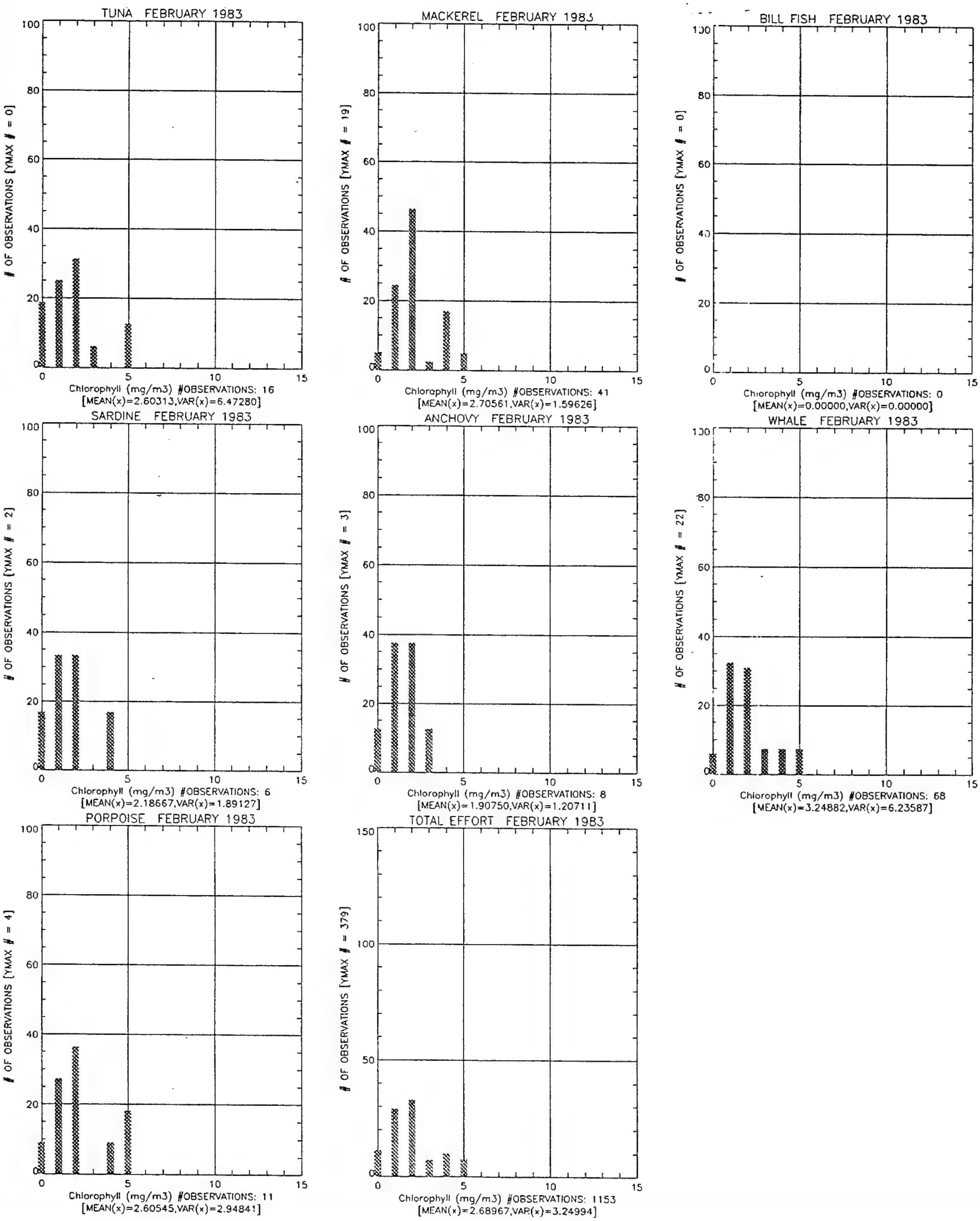

TUNA FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 16
[MEAN(x)=2.60313,VAR(x)=6.47280]
MACKEREL FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 19]
Chlorophyll (mg/m3) #OBSERVATIONS: 41
[MEAN(x)=2.70561,VAR(x)=1.59626]
BILL FISH FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 2]
Chlorophyll (mg/m3) #OBSERVATIONS: 6
[MEAN(x)=2.18667,VAR(x)=1.89127]
ANCHOVY FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 3]
Chlorophyll (mg/m3) #OBSERVATIONS: 8
[MEAN(x)=1.90750,VAR(x)=1.20711]
WHALE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 22]
Chlorophyll (mg/m3) #OBSERVATIONS: 68
[MEAN(x)=3.24882,VAR(x)=6.23587]
PORPOISE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 4]
Chlorophyll (mg/m3) #OBSERVATIONS: 11
[MEAN(x)=2.60545,VAR(x)=2.94841]
TOTAL EFFORT FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 379]
Chlorophyll (mg/m3) #OBSERVATIONS: 1153
[MEAN(x)=2.68967,VAR(x)=3.24994]

Figure 39

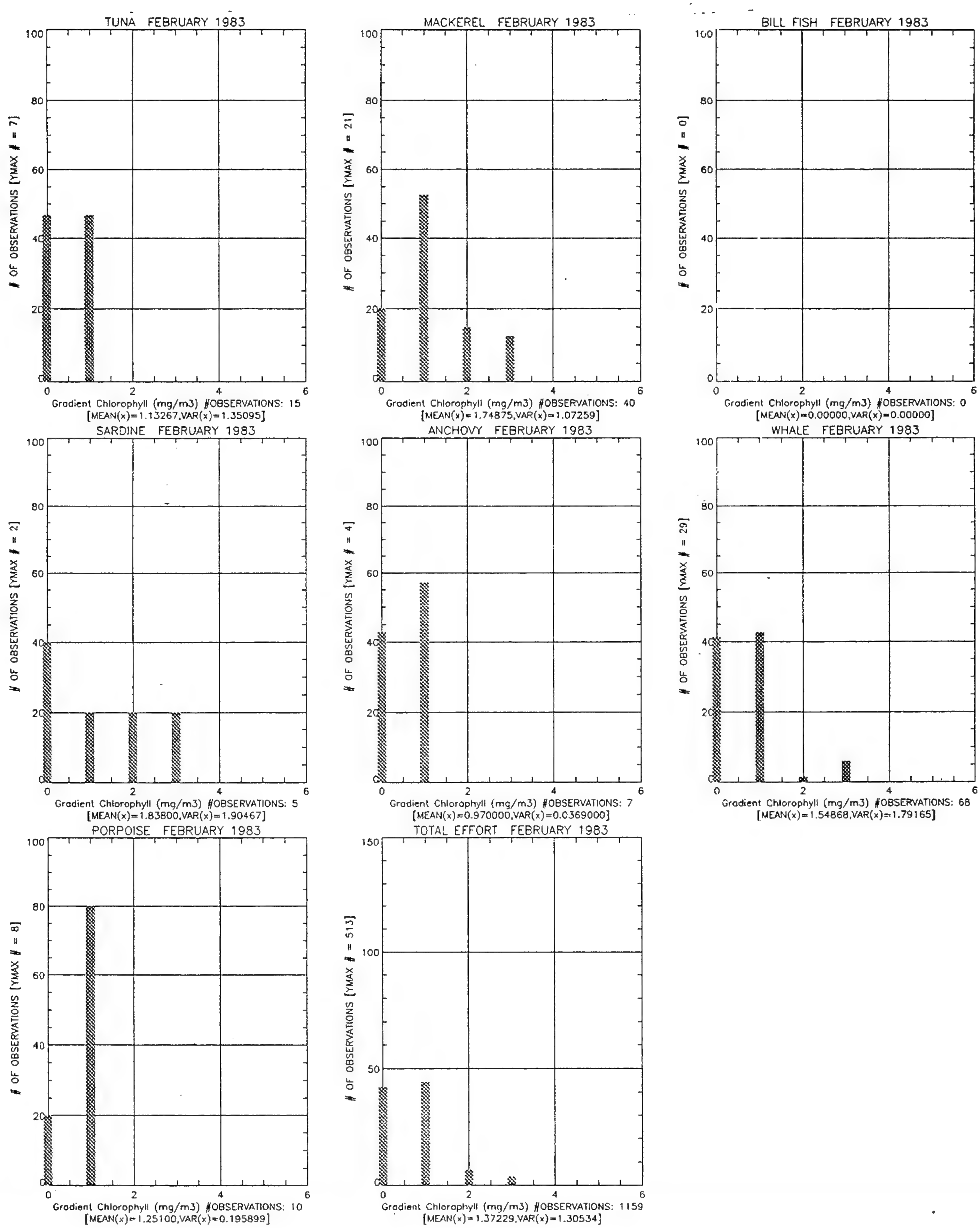

TUNA FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 7]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 15
[MEAN(x)=1.13267,VAR(x)=1.35095]
MACKEREL FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 21]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 40
[MEAN(x)=1.74875,VAR(x)=1.07259]
BILL FISH FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 5
[MEAN(x)=1.83800,VAR(x)=1.90467]
ANCHOVY FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 4]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 7
[MEAN(x)=0.970000,VAR(x)=0.0369000]
WHALE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 29]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 68
[MEAN(x)=1.54868,VAR(x)=1.79165]
PORPOISE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 8]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 10
[MEAN(x)=1.25100,VAR(x)=0.195899]
TOTAL EFFORT FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 513]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 1159
[MEAN(x)=1.37229,VAR(x)=1.30534]

Figure 40

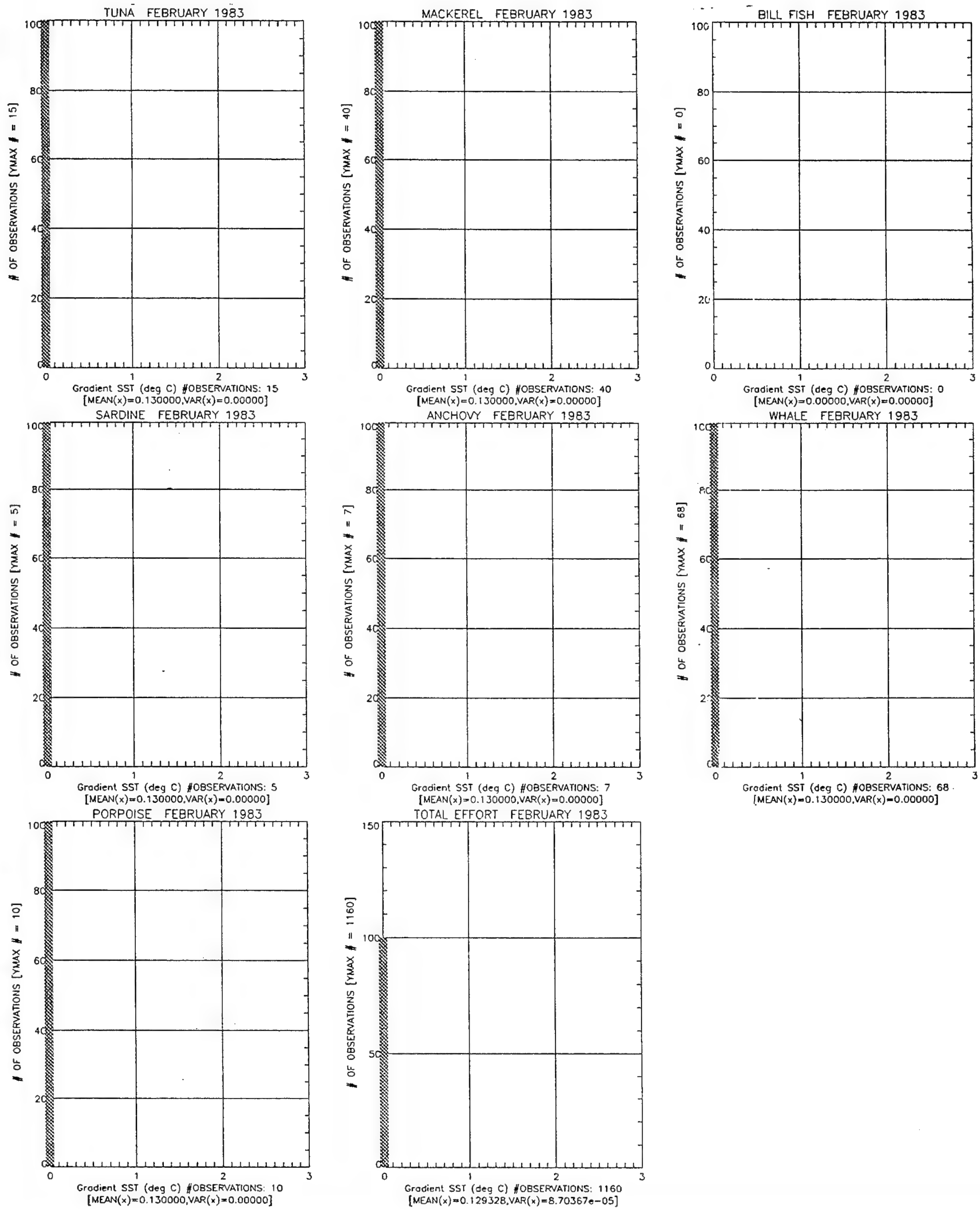

TUNA FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 15]
Gradient SST (deg C) #OBSERVATIONS: 15
[MEAN(x)=0.130000,VAR(x)=0.00000]
MACKEREL FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 40]
Gradient SST (deg C) #OBSERVATIONS: 40
[MEAN(x)=0.130000,VAR(x)=0.00000]
BILL FISH FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 5]
Gradient SST (deg C) #OBSERVATIONS: 5
[MEAN(x)=0.130000,VAR(x)=0.00000]
ANCHOVY FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 7]
Gradient SST (deg C) #OBSERVATIONS: 7
[MEAN(x)=0.130000,VAR(x)=0.00000]
WHALE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 68]
Gradient SST (deg C) #OBSERVATIONS: 68
[MEAN(x)=0.130000,VAR(x)=0.00000]
PORPOISE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 10]
Gradient SST (deg C) #OBSERVATIONS: 10
[MEAN(x)=0.130000,VAR(x)=0.00000]
TOTAL EFFORT FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 1160]
Gradient SST (deg C) #OBSERVATIONS: 1160
[MEAN(x)=0.129328,VAR(x)=8.70367e-05]

Figure 41

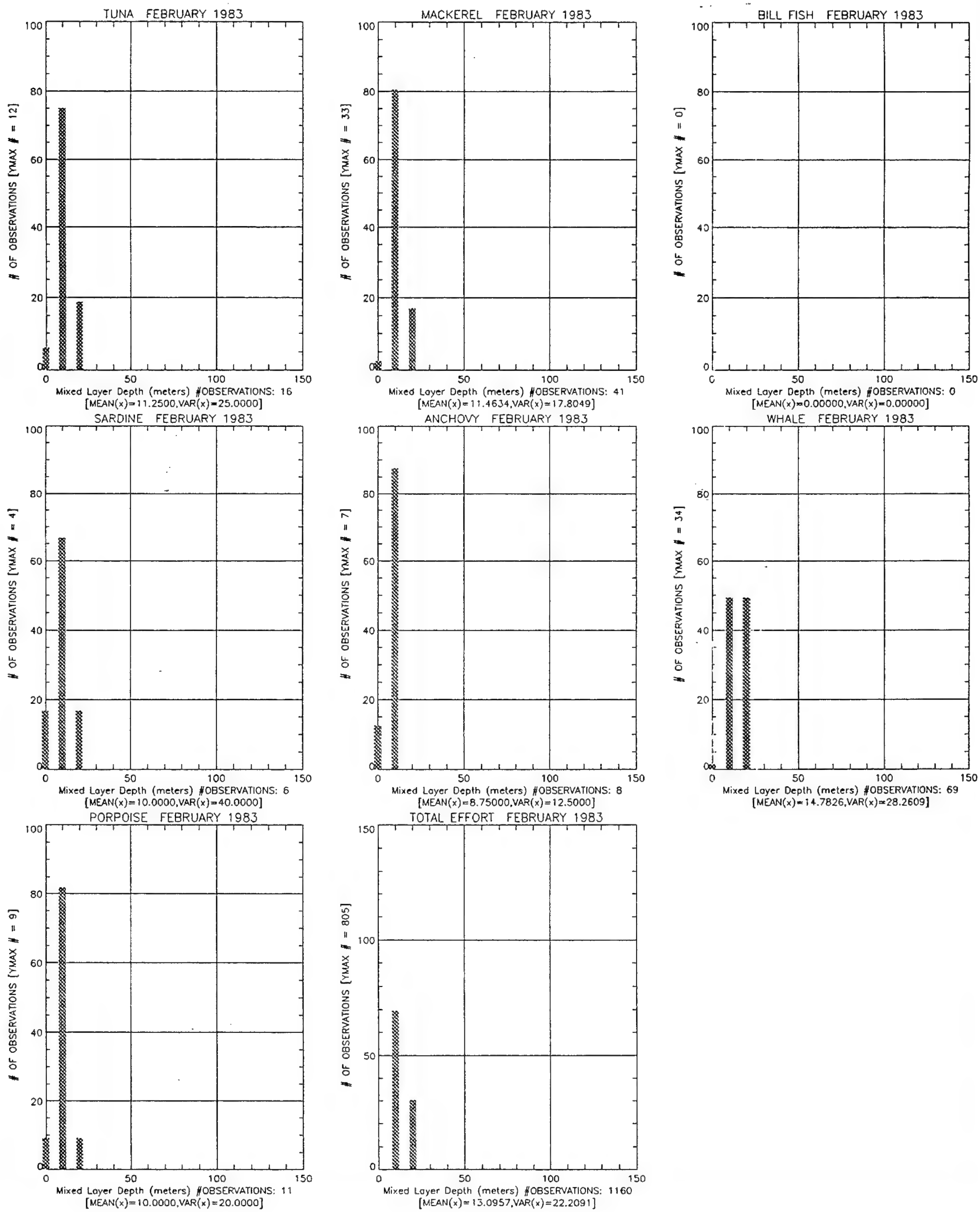
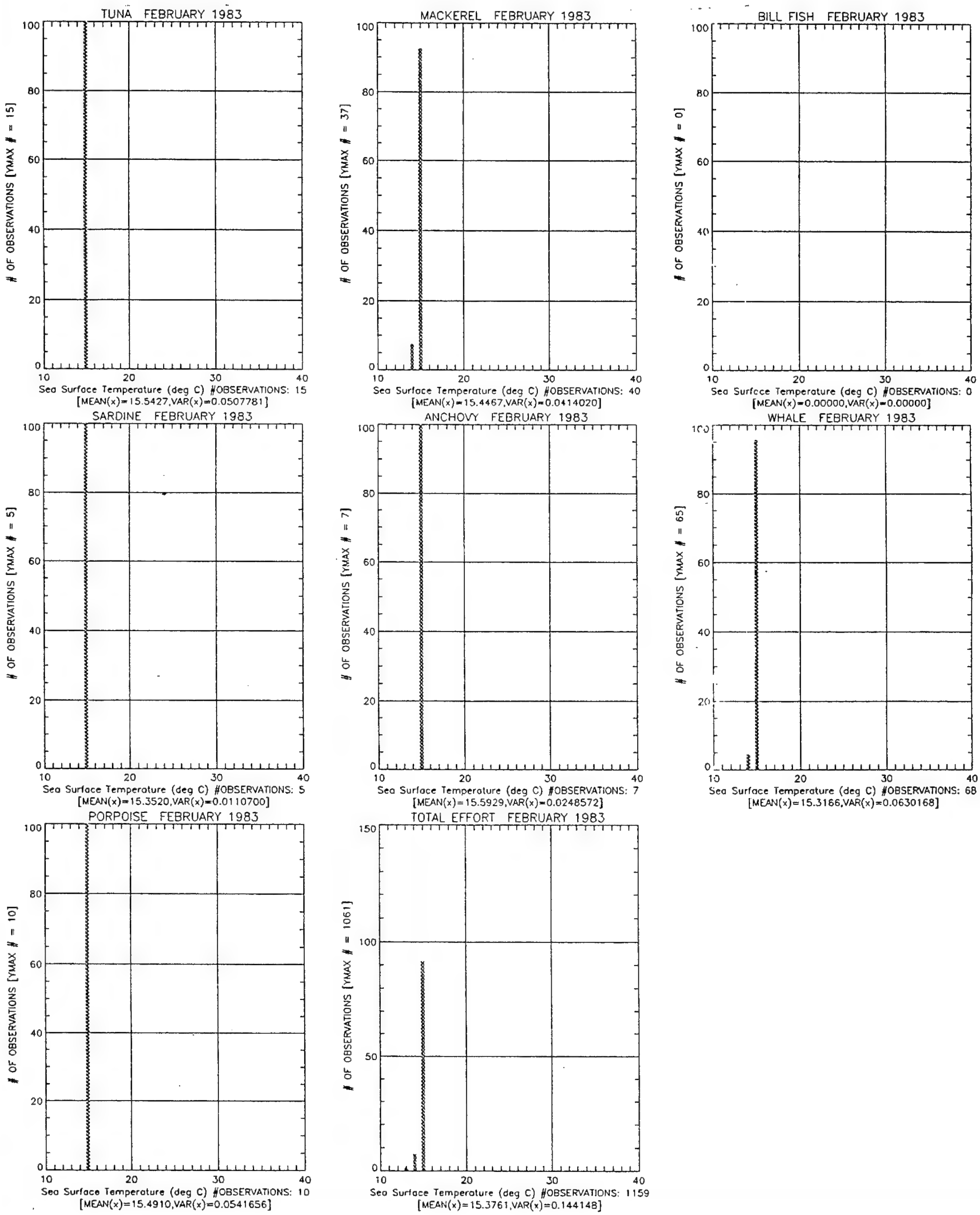

TUNA FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 12]
Mixed Layer Depth (meters) #OBSERVATIONS: 16
[MEAN(x)=11.2500,VAR(x)=25.0000]
MACKEREL FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 33]
Mixed Layer Depth (meters) #OBSERVATIONS: 41
[MEAN(x)=11.4634,VAR(x)=17.8049]
BILL FISH FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 4]
Mixed Layer Depth (meters) #OBSERVATIONS: 6
[MEAN(x)=10.0000,VAR(x)=40.0000]
ANCHOVY FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 7]
Mixed Layer Depth (meters) #OBSERVATIONS: 8
[MEAN(x)=8.75000,VAR(x)=12.5000]
WHALE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 34]
Mixed Layer Depth (meters) #OBSERVATIONS: 69
[MEAN(x)=14.7826,VAR(x)=28.2609]
PORPOISE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 9]
Mixed Layer Depth (meters) #OBSERVATIONS: 11
[MEAN(x)=10.0000,VAR(x)=20.0000]
TOTAL EFFORT FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 805]
Mixed Layer Depth (meters) #OBSERVATIONS: 1160
[MEAN(x)=13.0957,VAR(x)=22.2091]

Figure 42



TUNA FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 15]
Sea Surface Temperature (deg C) #OBSERVATIONS: 15
[MEAN(x)=15.5427,VAR(x)=0.0507781]
MACKEREL FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 37]
Sea Surface Temperature (deg C) #OBSERVATIONS: 40
[MEAN(x)=15.4467,VAR(x)=0.0414020]
BILL FISH FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 5]
Sea Surface Temperature (deg C) #OBSERVATIONS: 5
[MEAN(x)=15.3520,VAR(x)=0.0110700]
ANCHOVY FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 7]
Sea Surface Temperature (deg C) #OBSERVATIONS: 7
[MEAN(x)=15.5929,VAR(x)=0.0248572]
WHALE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 65]
Sea Surface Temperature (deg C) #OBSERVATIONS: 68
[MEAN(x)=15.3166,VAR(x)=0.0630168]
PORPOISE FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 10]
Sea Surface Temperature (deg C) #OBSERVATIONS: 10
[MEAN(x)=15.4910,VAR(x)=0.0541656]
TOTAL EFFORT FEBRUARY 1983
OF OBSERVATIONS [YMAX # = 1061]
Sea Surface Temperature (deg C) #OBSERVATIONS: 1159
[MEAN(x)=15.3761,VAR(x)=0.144148]

Figure 43

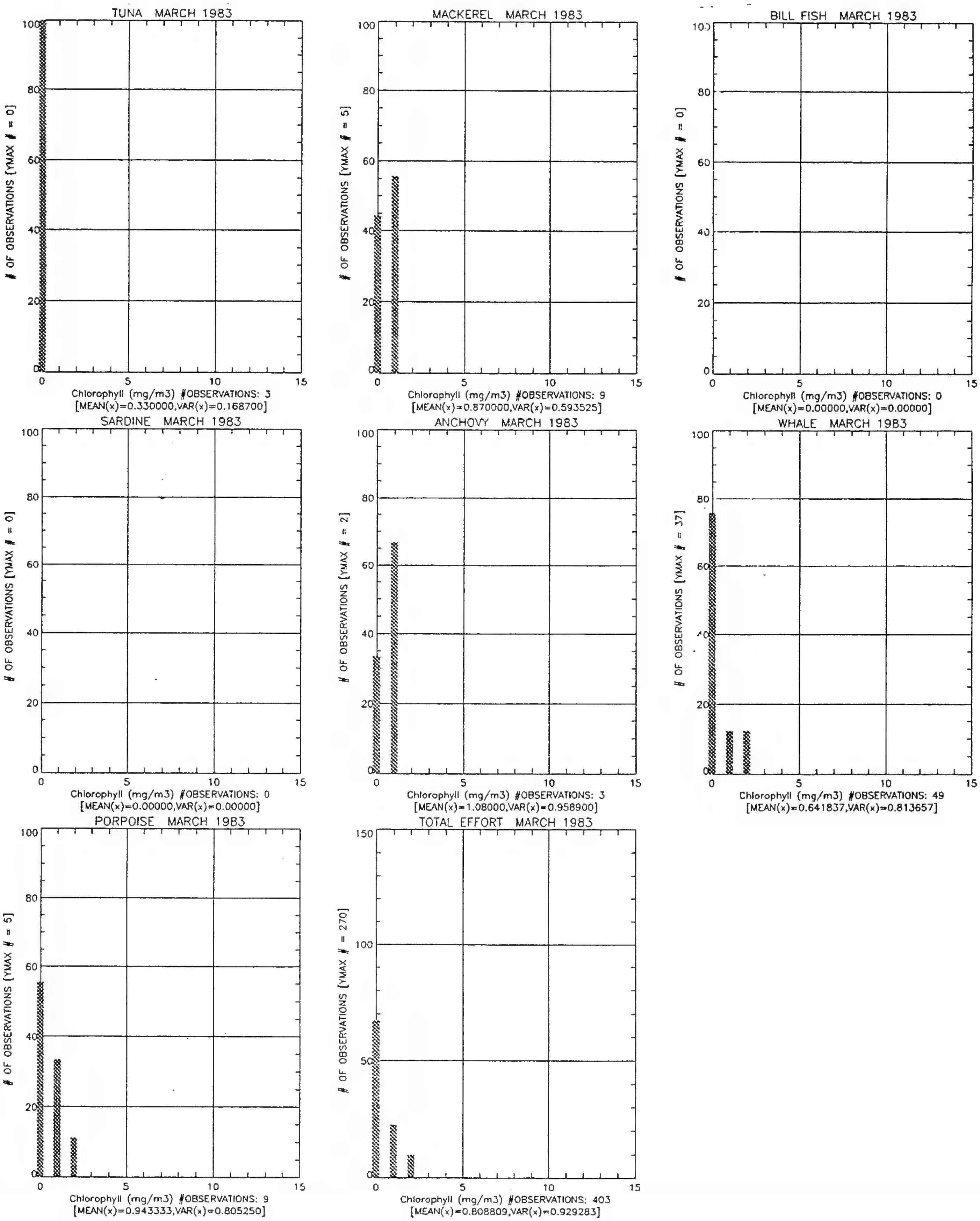

TUNA MARCH 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 3
[MEAN(x)=0.330000,VAR(x)=0.168700]
MACKEREL MARCH 1983
OF OBSERVATIONS [YMAX # = 5]
Chlorophyll (mg/m3) #OBSERVATIONS: 9
[MEAN(x)=0.870000,VAR(x)=0.593525]
BILL FISH MARCH 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE MARCH 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY MARCH 1983
OF OBSERVATIONS [YMAX # = 2]
Chlorophyll (mg/m3) #OBSERVATIONS: 3
[MEAN(x)=1.08000,VAR(x)=0.958900]
WHALE MARCH 1983
OF OBSERVATIONS [YMAX # = 37]
Chlorophyll (mg/m3) #OBSERVATIONS: 49
[MEAN(x)=0.641837,VAR(x)=0.813657]
PORPOISE MARCH 1983
OF OBSERVATIONS [YMAX # = 5]
Chlorophyll (mg/m3) #OBSERVATIONS: 9
[MEAN(x)=0.943333,VAR(x)=0.805250]
TOTAL EFFORT MARCH 1983
OF OBSERVATIONS [YMAX # = 270]
Chlorophyll (mg/m3) #OBSERVATIONS: 403
[MEAN(x)=0.808809,VAR(x)=0.929283]

Figure 44

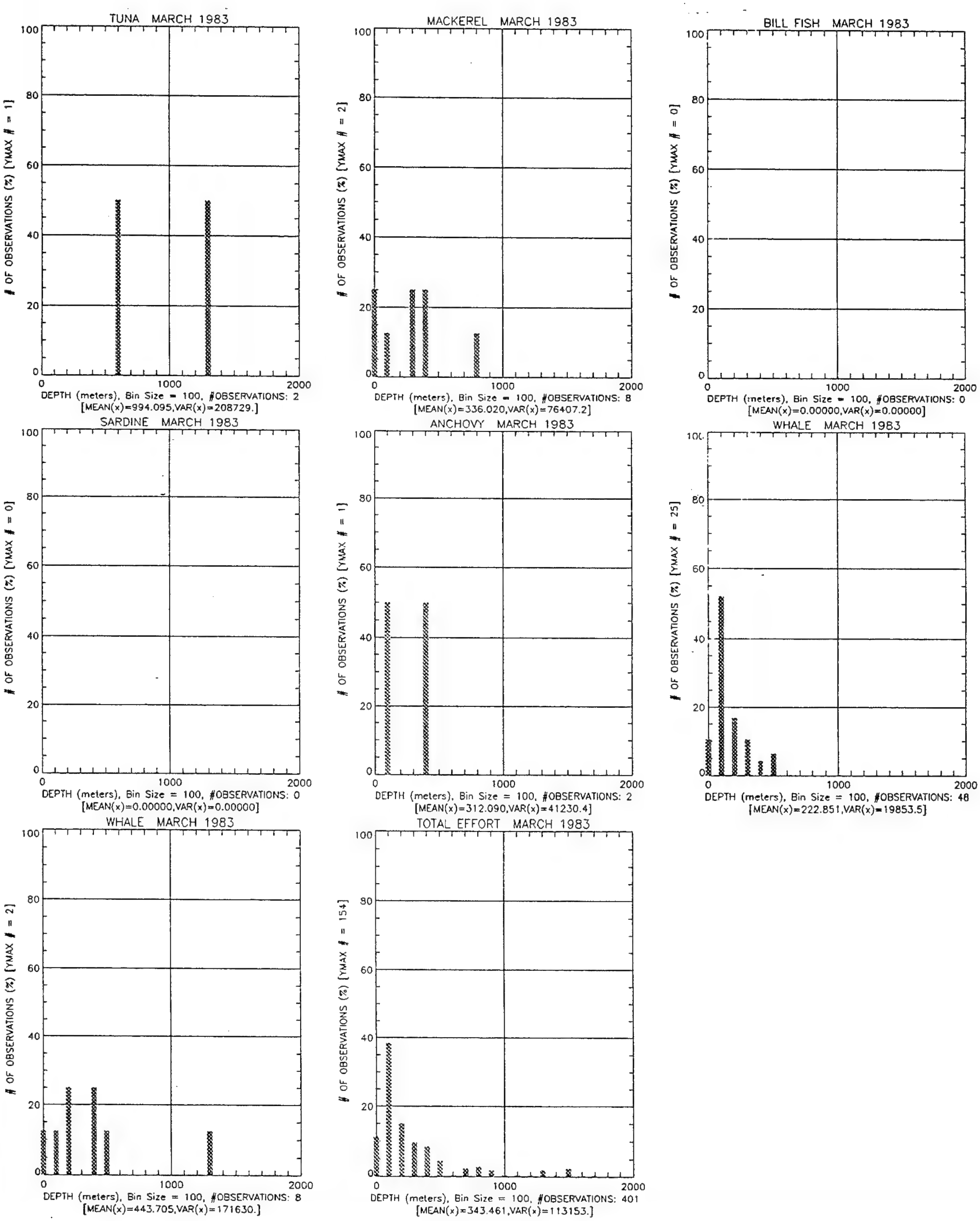

TUNA MARCH 1983
OF OBSERVATIONS (%) [YMAX # = 1]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 2
[MEAN(x)=994.095,VAR(x)=208729.]
MACKEREL MARCH 1983
OF OBSERVATIONS (%) [YMAX # = 2]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 8
[MEAN(x)=336.020,VAR(x)=76407.2]
BILL FISH MARCH 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE MARCH 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY MARCH 1983
OF OBSERVATIONS (%) [YMAX # = 1]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 2
[MEAN(x)=312.090,VAR(x)=41230.4]
WHALE MARCH 1983
OF OBSERVATIONS (%) [YMAX # = 25]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 48
[MEAN(x)=222.851,VAR(x)=19853.5]
WHALE MARCH 1983
OF OBSERVATIONS (%) [YMAX # = 2]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 8
[MEAN(x)=443.705,VAR(x)=171630.]
TOTAL EFFORT MARCH 1983
OF OBSERVATIONS (%) [YMAX # = 154]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 401
[MEAN(x)=343.461,VAR(x)=113153.]

Figure 45

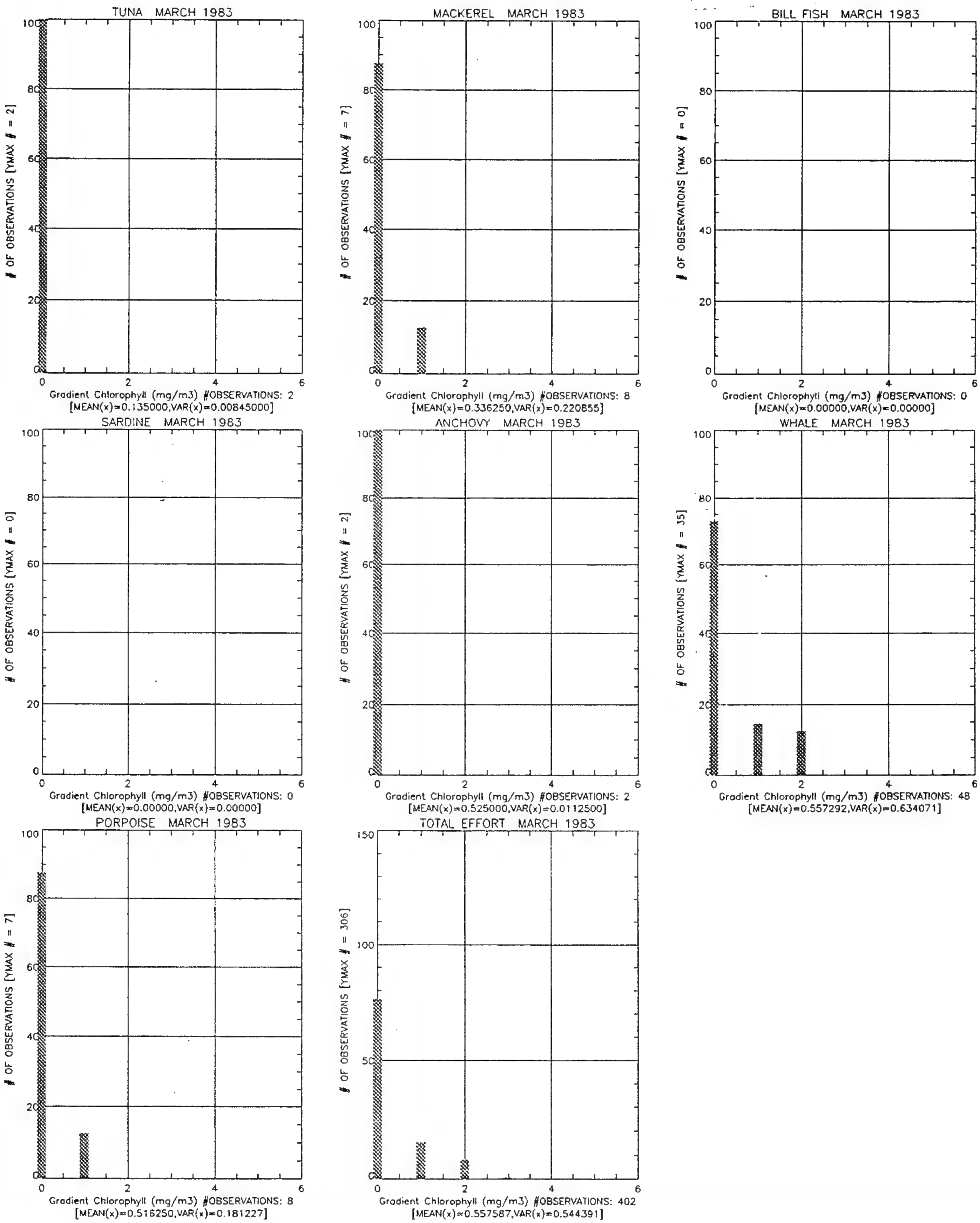

TUNA MARCH 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 2
[MEAN(x)=0.135000,VAR(x)=0.00845000]
MACKEREL MARCH 1983
OF OBSERVATIONS [YMAX # = 7]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 8
[MEAN(x)=0.336250,VAR(x)=0.220855]
BILL FISH MARCH 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE MARCH 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY MARCH 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 2
[MEAN(x)=0.525000,VAR(x)=0.0112500]
WHALE MARCH 1983
OF OBSERVATIONS [YMAX # = 35]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 48
[MEAN(x)=0.557292,VAR(x)=0.634071]
PORPOISE MARCH 1983
OF OBSERVATIONS [YMAX # = 7]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 8
[MEAN(x)=0.516250,VAR(x)=0.181227]
TOTAL EFFORT MARCH 1983
OF OBSERVATIONS [YMAX # = 306]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 402
[MEAN(x)=0.557587,VAR(x)=0.544391]

Figure 46

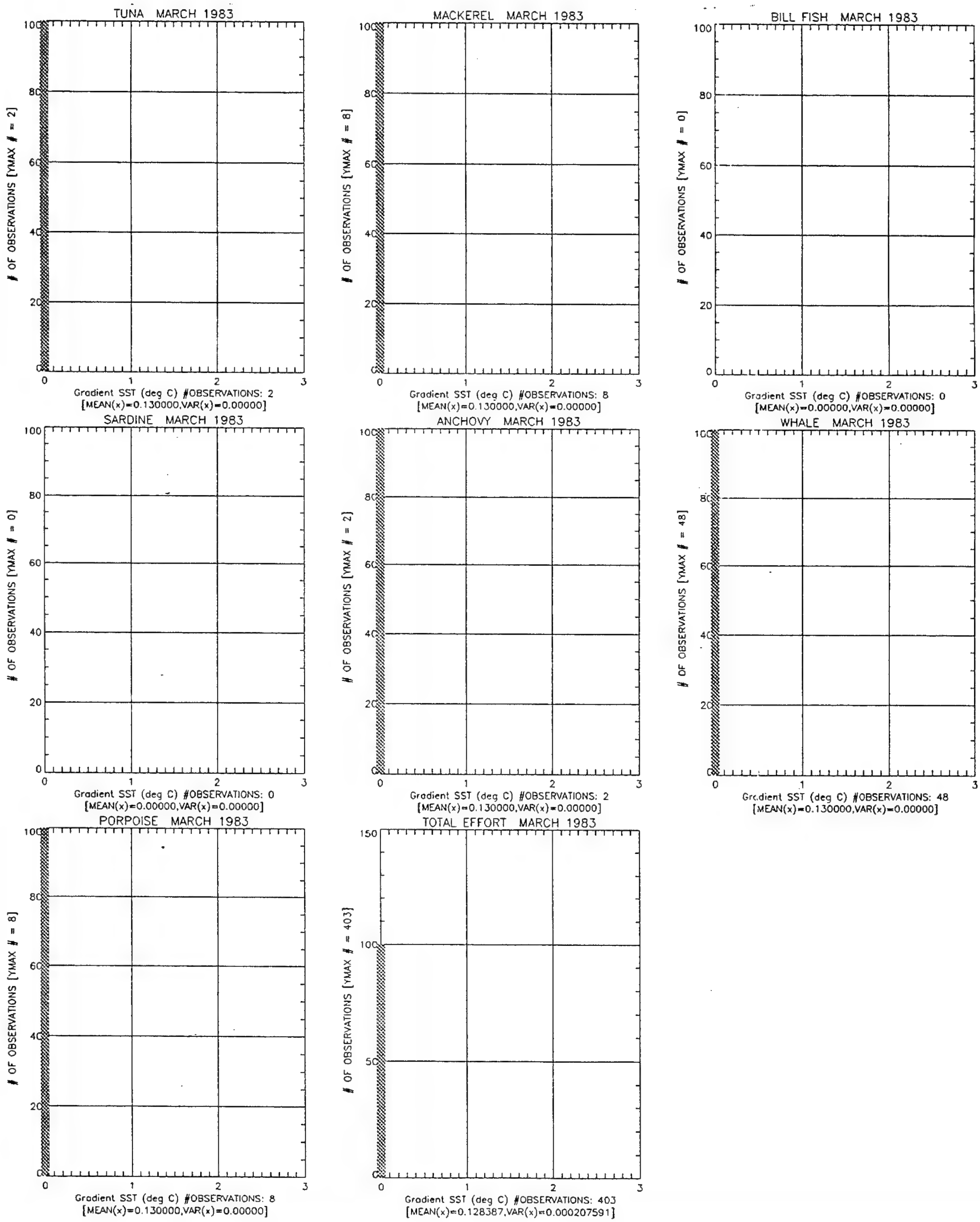
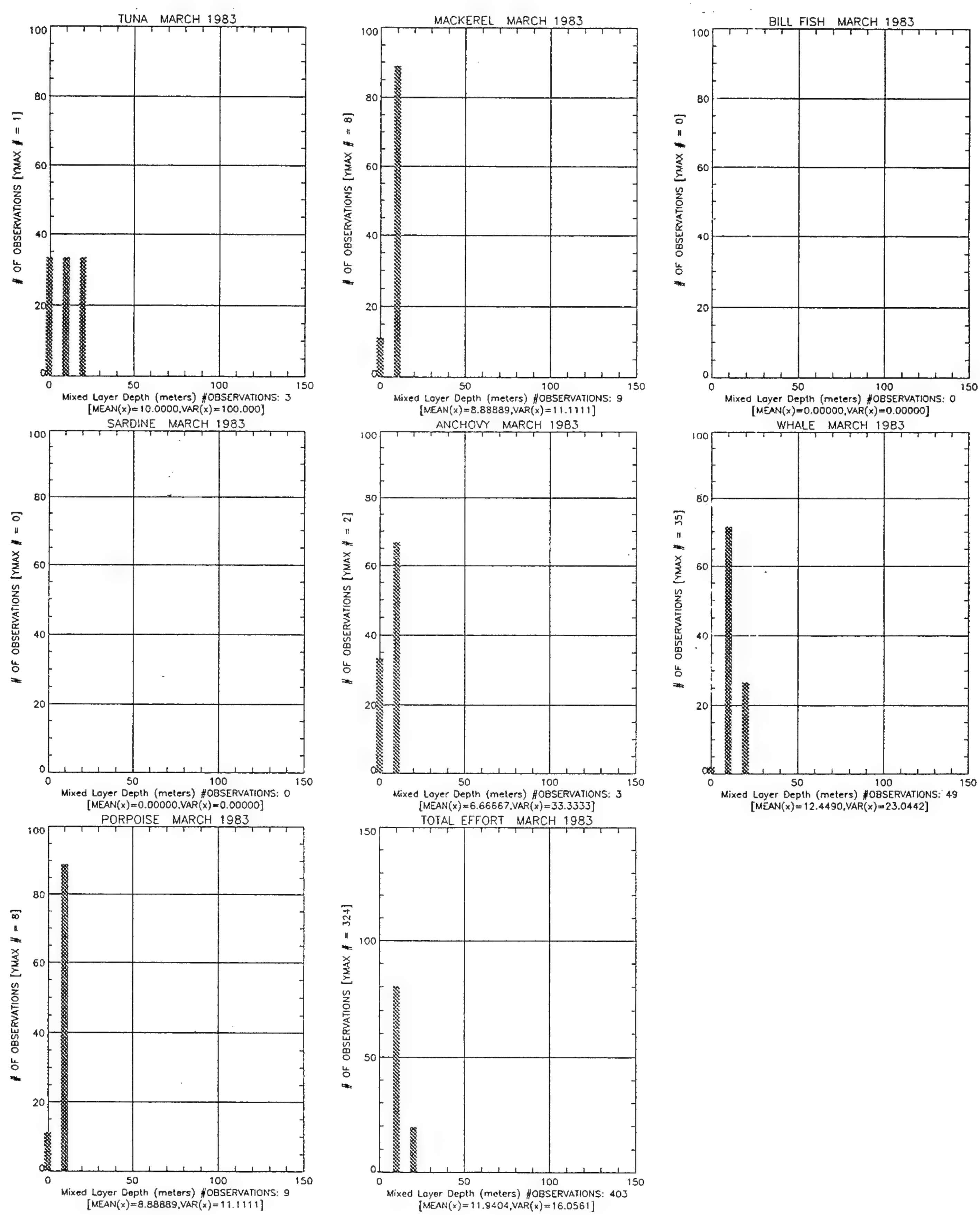
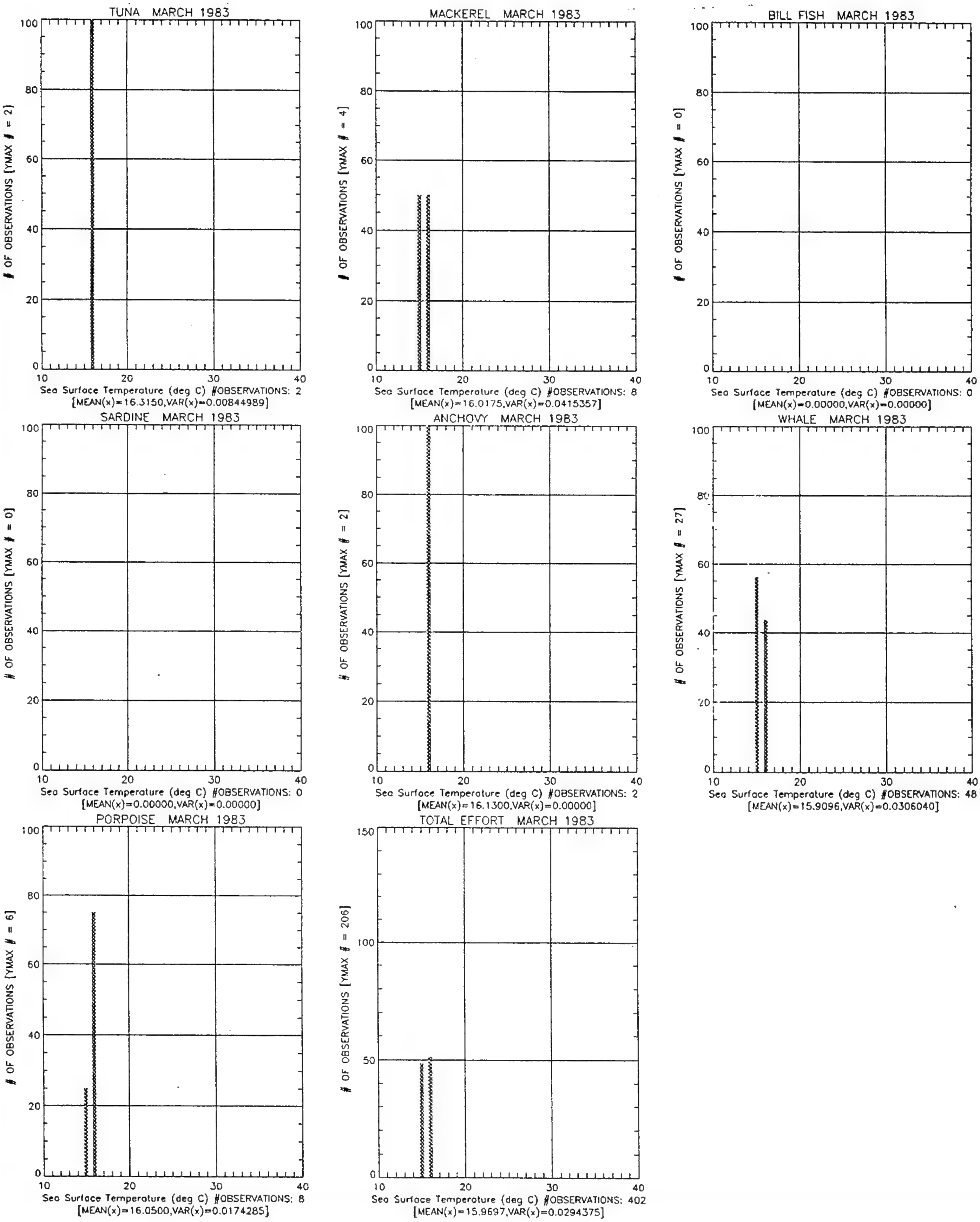

TUNA MARCH 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient SST (deg C) #OBSERVATIONS: 2
[MEAN(x)=0.130000,VAR(x)=0.00000]
MACKEREL MARCH 1983
OF OBSERVATIONS [YMAX # = 8]
Gradient SST (deg C) #OBSERVATIONS: 8
[MEAN(x)=0.130000,VAR(x)=0.00000]
BILL FISH MARCH 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE MARCH 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY MARCH 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient SST (deg C) #OBSERVATIONS: 2
[MEAN(x)=0.130000,VAR(x)=0.00000]
WHALE MARCH 1983
OF OBSERVATIONS [YMAX # = 48]
Gradient SST (deg C) #OBSERVATIONS: 48
[MEAN(x)=0.130000,VAR(x)=0.00000]
PORPOISE MARCH 1983
OF OBSERVATIONS [YMAX # = 8]
Gradient SST (deg C) #OBSERVATIONS: 8
[MEAN(x)=0.130000,VAR(x)=0.00000]
TOTAL EFFORT MARCH 1983
OF OBSERVATIONS [YMAX # = 403]
Gradient SST (deg C) #OBSERVATIONS: 403
[MEAN(x)=0.128387,VAR(x)=0.000207591]

Figure 47



TUNA MARCH 1983
OF OBSERVATIONS [YMAX # = 1]
Mixed Layer Depth (meters) #OBSERVATIONS: 3
[MEAN(x)=10.0000,VAR(x)=100.000]
MACKEREL MARCH 1983
OF OBSERVATIONS [YMAX # = 8]
Mixed Layer Depth (meters) #OBSERVATIONS: 9
[MEAN(x)=8.88889,VAR(x)=11.1111]
BILL FISH MARCH 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE MARCH 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY MARCH 1983
OF OBSERVATIONS [YMAX # = 2]
Mixed Layer Depth (meters) #OBSERVATIONS: 3
[MEAN(x)=6.66667,VAR(x)=33.3333]
WHALE MARCH 1983
OF OBSERVATIONS [YMAX # = 35]
Mixed Layer Depth (meters) #OBSERVATIONS: 49
[MEAN(x)=12.4490,VAR(x)=23.0442]
PORPOISE MARCH 1983
OF OBSERVATIONS [YMAX # = 8]
Mixed Layer Depth (meters) #OBSERVATIONS: 9
[MEAN(x)=8.88889,VAR(x)=11.1111]
TOTAL EFFORT MARCH 1983
OF OBSERVATIONS [YMAX # = 324]
Mixed Layer Depth (meters) #OBSERVATIONS: 403
[MEAN(x)=11.9404,VAR(x)=16.0561]

Figure 48



TUNA MARCH 1983
OF OBSERVATIONS [YMAX # = 2]
Sea Surface Temperature (deg C) #OBSERVATIONS: 2
[MEAN(x)=16.3150,VAR(x)=0.00844989]
MACKEREL MARCH 1983
OF OBSERVATIONS [YMAX # = 4]
Sea Surface Temperature (deg C) #OBSERVATIONS: 8
[MEAN(x)=16.0175,VAR(x)=0.0415357]
BILL FISH MARCH 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE MARCH 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY MARCH 1983
OF OBSERVATIONS [YMAX # = 2]
Sea Surface Temperature (deg C) #OBSERVATIONS: 2
[MEAN(x)=16.1300,VAR(x)=0.00000]
WHALE MARCH 1983
OF OBSERVATIONS [YMAX # = 27]
Sea Surface Temperature (deg C) #OBSERVATIONS: 48
[MEAN(x)=15.9096,VAR(x)=0.0306040]
PORPOISE MARCH 1983
OF OBSERVATIONS [YMAX # = 6]
Sea Surface Temperature (deg C) #OBSERVATIONS: 8
[MEAN(x)=16.0500,VAR(x)=0.0174285]
TOTAL EFFORT MARCH 1983
OF OBSERVATIONS [YMAX # = 206]
Sea Surface Temperature (deg C) #OBSERVATIONS: 402
[MEAN(x)=15.9697,VAR(x)=0.0294375]

Figure 49

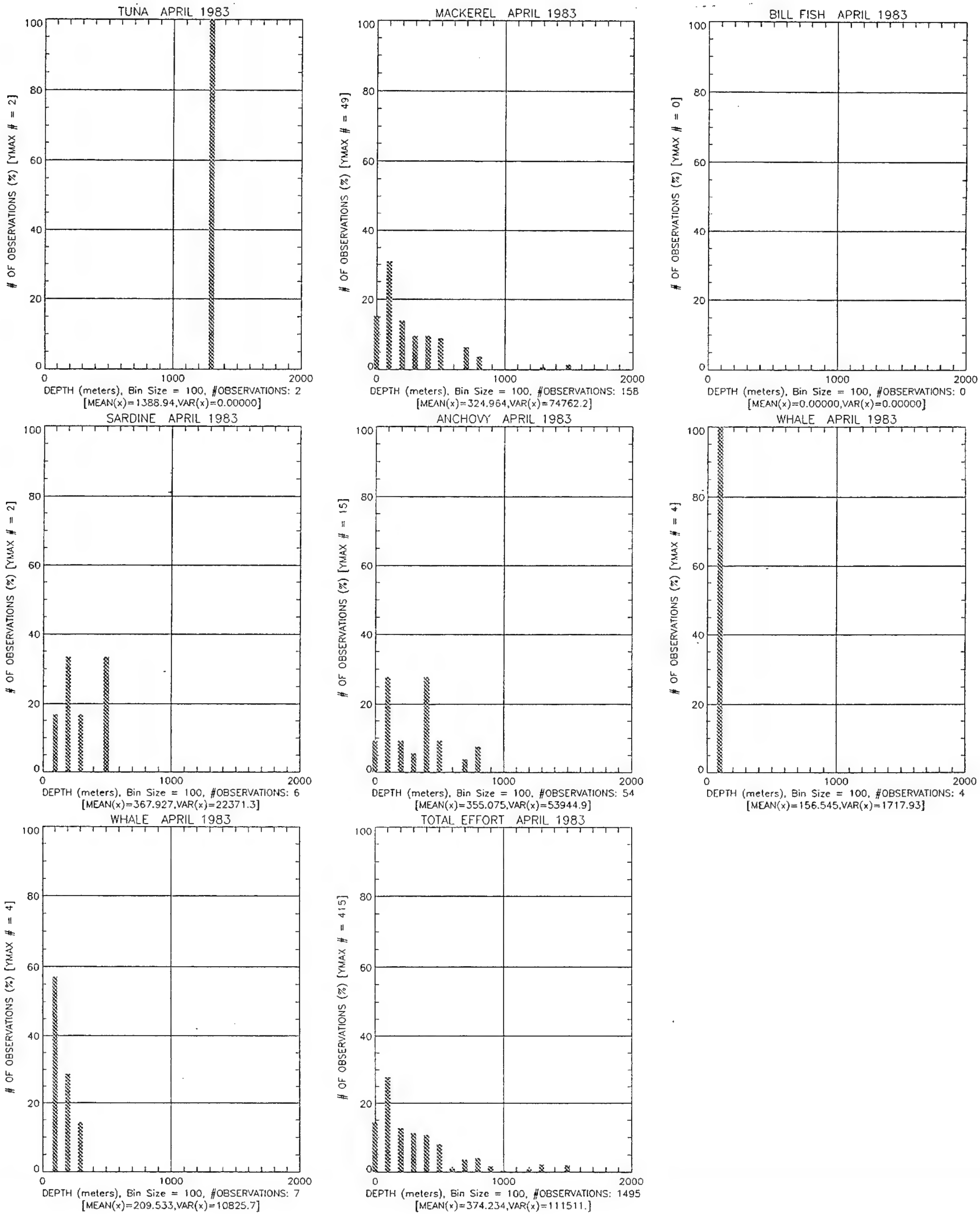

TUNA APRIL 1983
OF OBSERVATIONS (%) [YMAX # = 2]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 2
[MEAN(x)=1388.94,VAR(x)=0.00000]
MACKEREL APRIL 1983
OF OBSERVATIONS (%) [YMAX # = 49]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 158
[MEAN(x)=324.964,VAR(x)=74762.2]
BILL FISH APRIL 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE APRIL 1983
OF OBSERVATIONS (%) [YMAX # = 2]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 6
[MEAN(x)=367.927,VAR(x)=22371.3]
ANCHOVY APRIL 1983
OF OBSERVATIONS (%) [YMAX # = 15]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 54
[MEAN(x)=355.075,VAR(x)=53944.9]
WHALE APRIL 1983
OF OBSERVATIONS (%) [YMAX # = 4]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 4
[MEAN(x)=156.545,VAR(x)=1717.93]
WHALE APRIL 1983
OF OBSERVATIONS (%) [YMAX # = 4]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 7
[MEAN(x)=209.533,VAR(x)=10825.7]
TOTAL EFFORT APRIL 1983
OF OBSERVATIONS (%) [YMAX # = 415]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 1495
[MEAN(x)=374.234,VAR(x)=111511.]

Figure 50

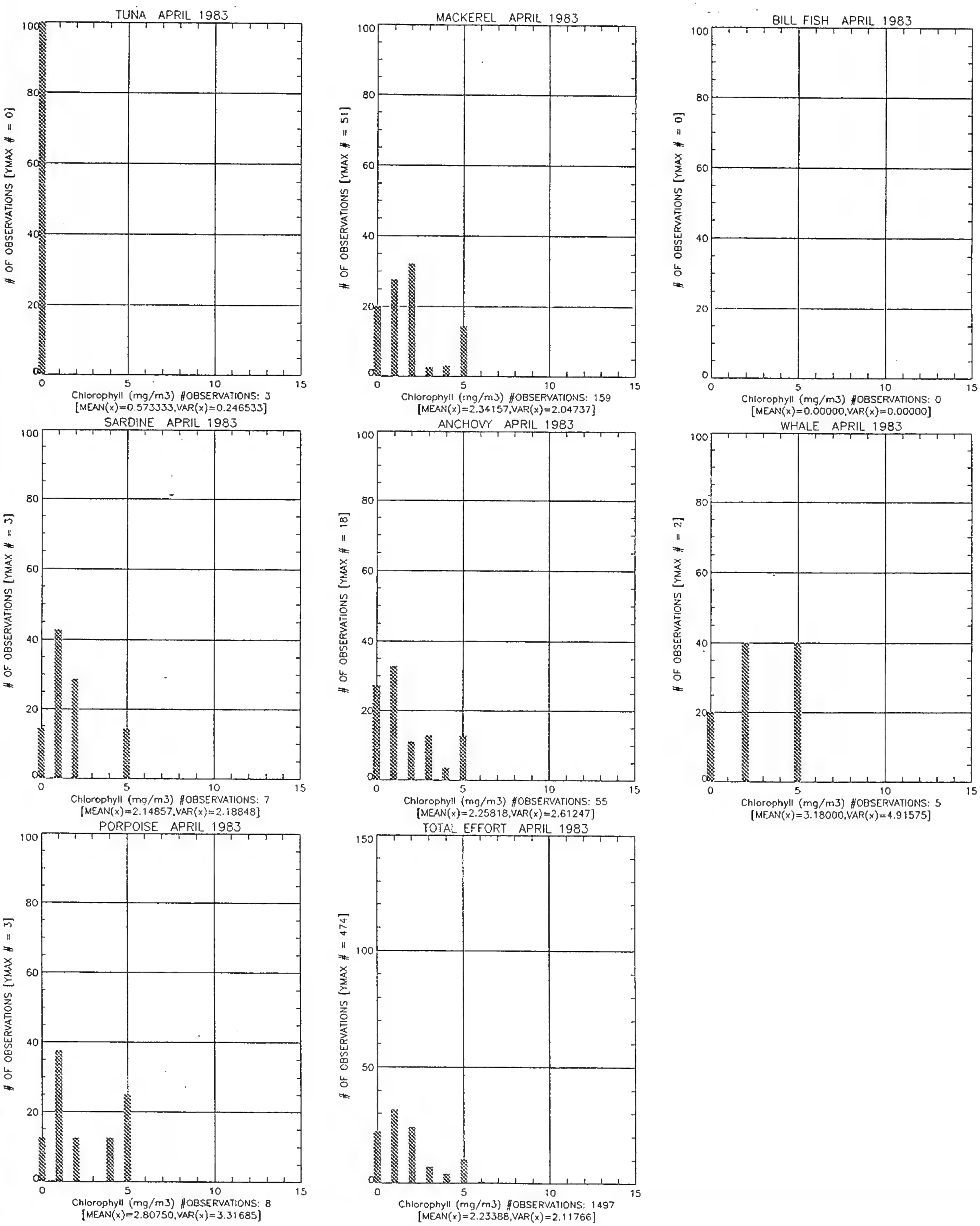
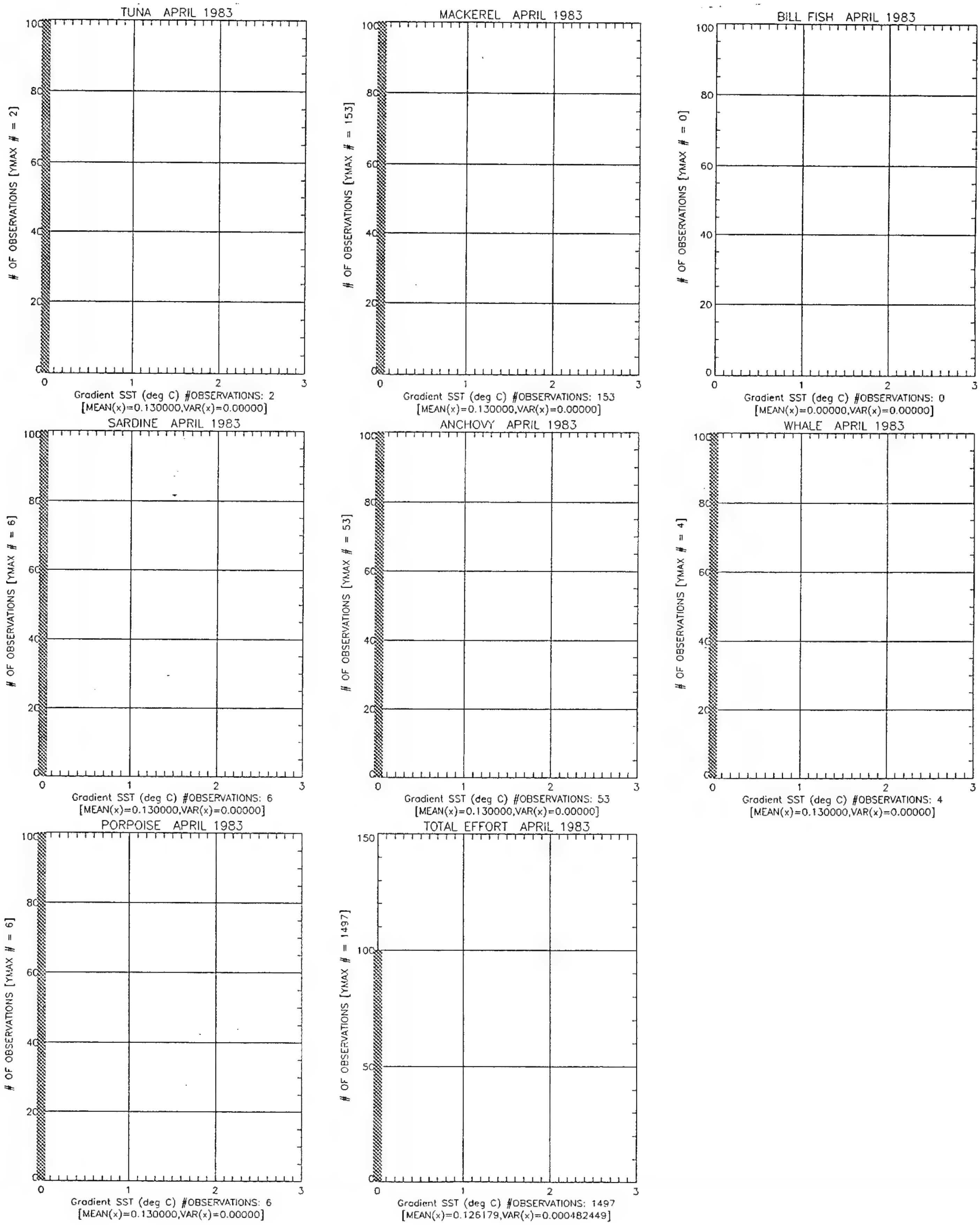
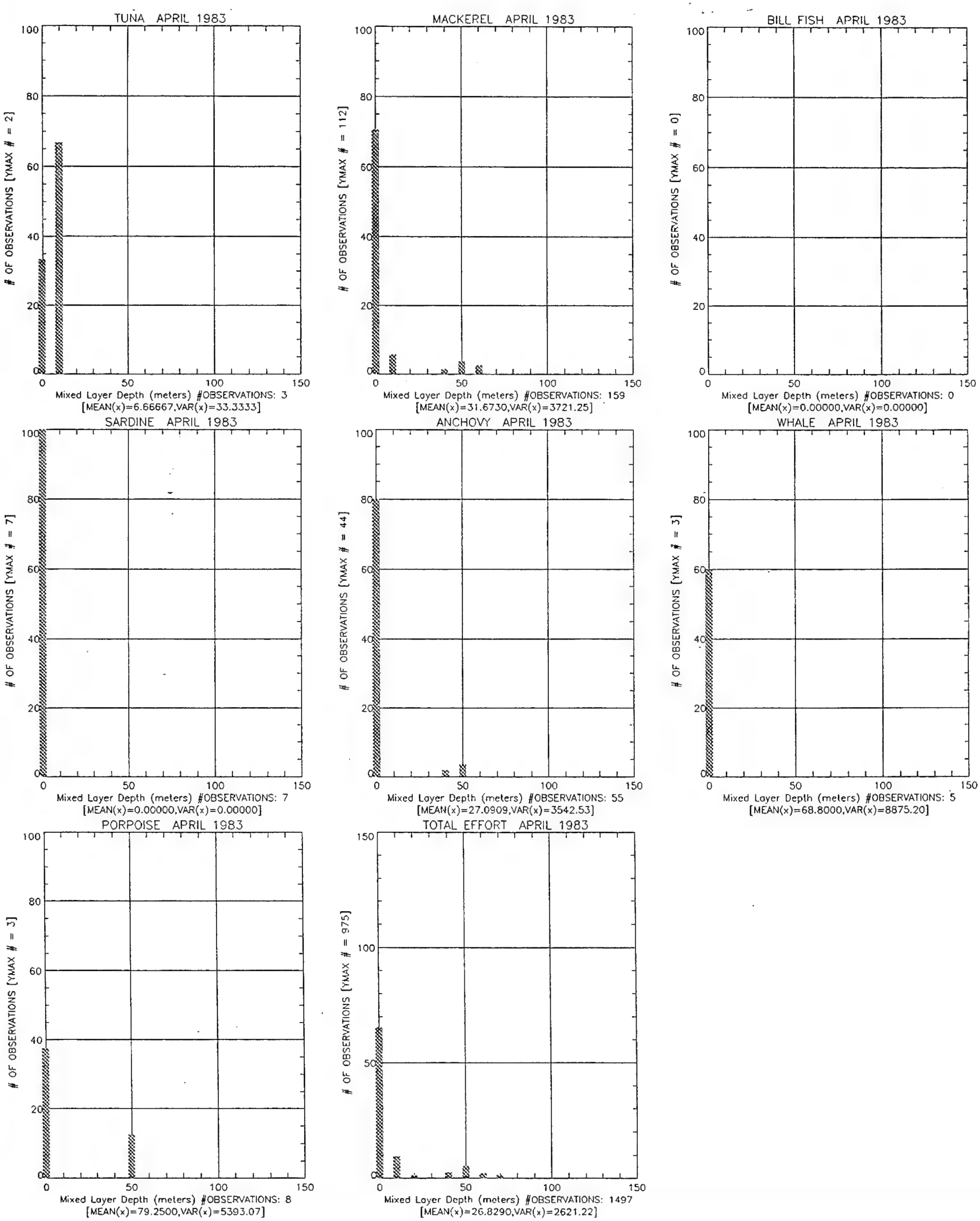

TUNA APRIL 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 3
[MEAN(x)=0.573333,VAR(x)=0.246533]
MACKEREL APRIL 1983
OF OBSERVATIONS [YMAX # = 51]
Chlorophyll (mg/m3) #OBSERVATIONS: 159
[MEAN(x)=2.34157,VAR(x)=2.04737]
BILL FISH APRIL 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE APRIL 1983
OF OBSERVATIONS [YMAX # = 3]
Chlorophyll (mg/m3) #OBSERVATIONS: 7
[MEAN(x)=2.14857,VAR(x)=2.18848]
ANCHOVY APRIL 1983
OF OBSERVATIONS [YMAX # = 18]
Chlorophyll (mg/m3) #OBSERVATIONS: 55
[MEAN(x)=2.25818,VAR(x)=2.61247]
WHALE APRIL 1983
OF OBSERVATIONS [YMAX # = 2]
Chlorophyll (mg/m3) #OBSERVATIONS: 5
[MEAN(x)=3.18000,VAR(x)=4.91575]
PORPOISE APRIL 1983
OF OBSERVATIONS [YMAX # = 3]
Chlorophyll (mg/m3) #OBSERVATIONS: 8
[MEAN(x)=2.80750,VAR(x)=3.31685]
TOTAL EFFORT APRIL 1983
OF OBSERVATIONS [YMAX # = 474]
Chlorophyll (mg/m3) #OBSERVATIONS: 1497
[MEAN(x)=2.23388,VAR(x)=2.11766]

Figure 51



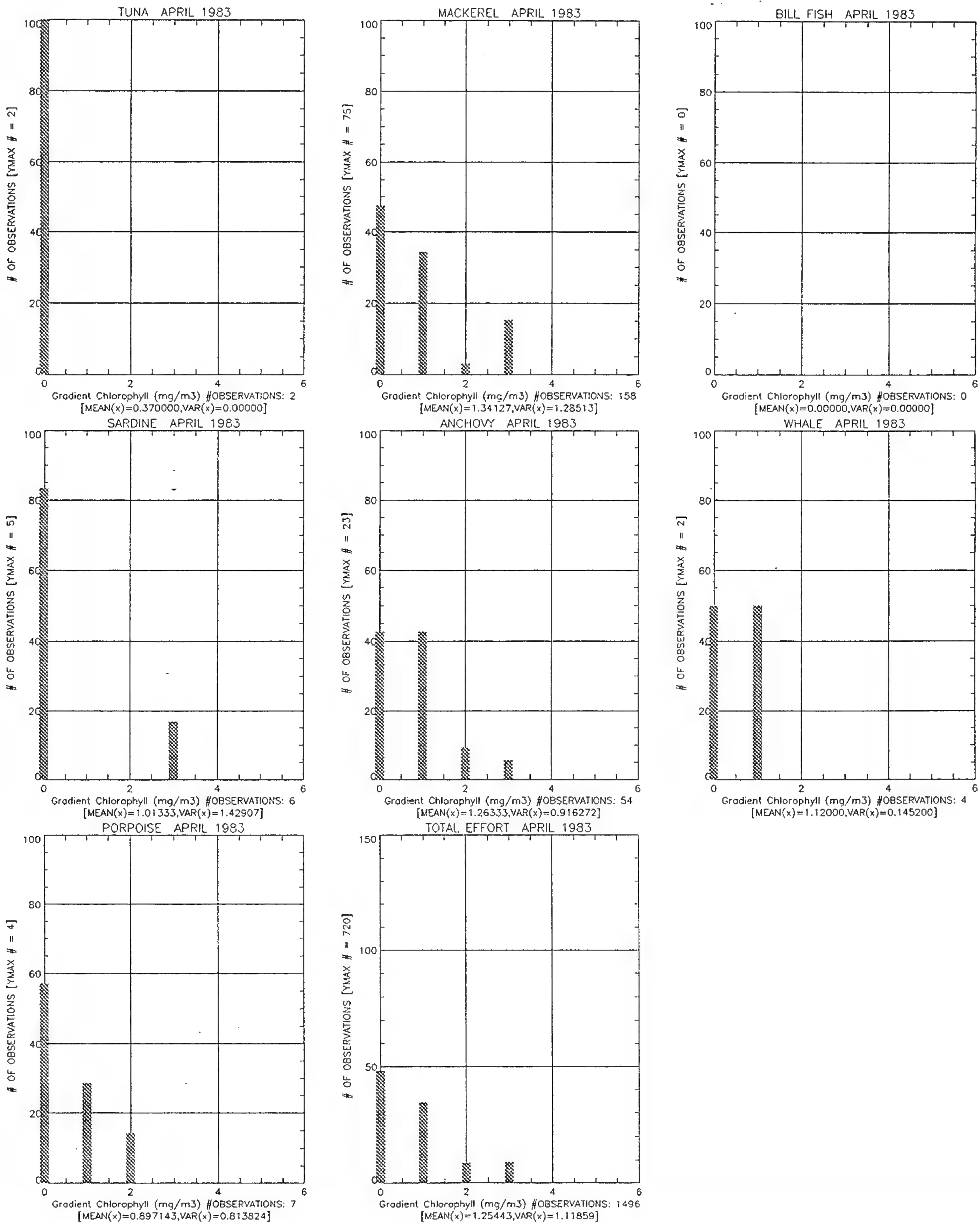
TUNA APRIL 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient SST (deg C) #OBSERVATIONS: 2
[MEAN(x)=0.130000,VAR(x)=0.00000]
MACKEREL APRIL 1983
OF OBSERVATIONS [YMAX # = 153]
Gradient SST (deg C) #OBSERVATIONS: 153
[MEAN(x)=0.130000,VAR(x)=0.00000]
BILL FISH APRIL 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE APRIL 1983
OF OBSERVATIONS [YMAX # = 6]
Gradient SST (deg C) #OBSERVATIONS: 6
[MEAN(x)=0.130000,VAR(x)=0.00000]
ANCHOVY APRIL 1983
OF OBSERVATIONS [YMAX # = 53]
Gradient SST (deg C) #OBSERVATIONS: 53
[MEAN(x)=0.130000,VAR(x)=0.00000]
WHALE APRIL 1983
OF OBSERVATIONS [YMAX # = 4]
Gradient SST (deg C) #OBSERVATIONS: 4
[MEAN(x)=0.130000,VAR(x)=0.00000]
PORPOISE APRIL 1983
OF OBSERVATIONS [YMAX # = 6]
Gradient SST (deg C) #OBSERVATIONS: 6
[MEAN(x)=0.130000,VAR(x)=0.00000]
TOTAL EFFORT APRIL 1983
OF OBSERVATIONS [YMAX # = 1497]
Gradient SST (deg C) #OBSERVATIONS: 1497
[MEAN(x)=0.126179,VAR(x)=0.000482449]

Figure 52



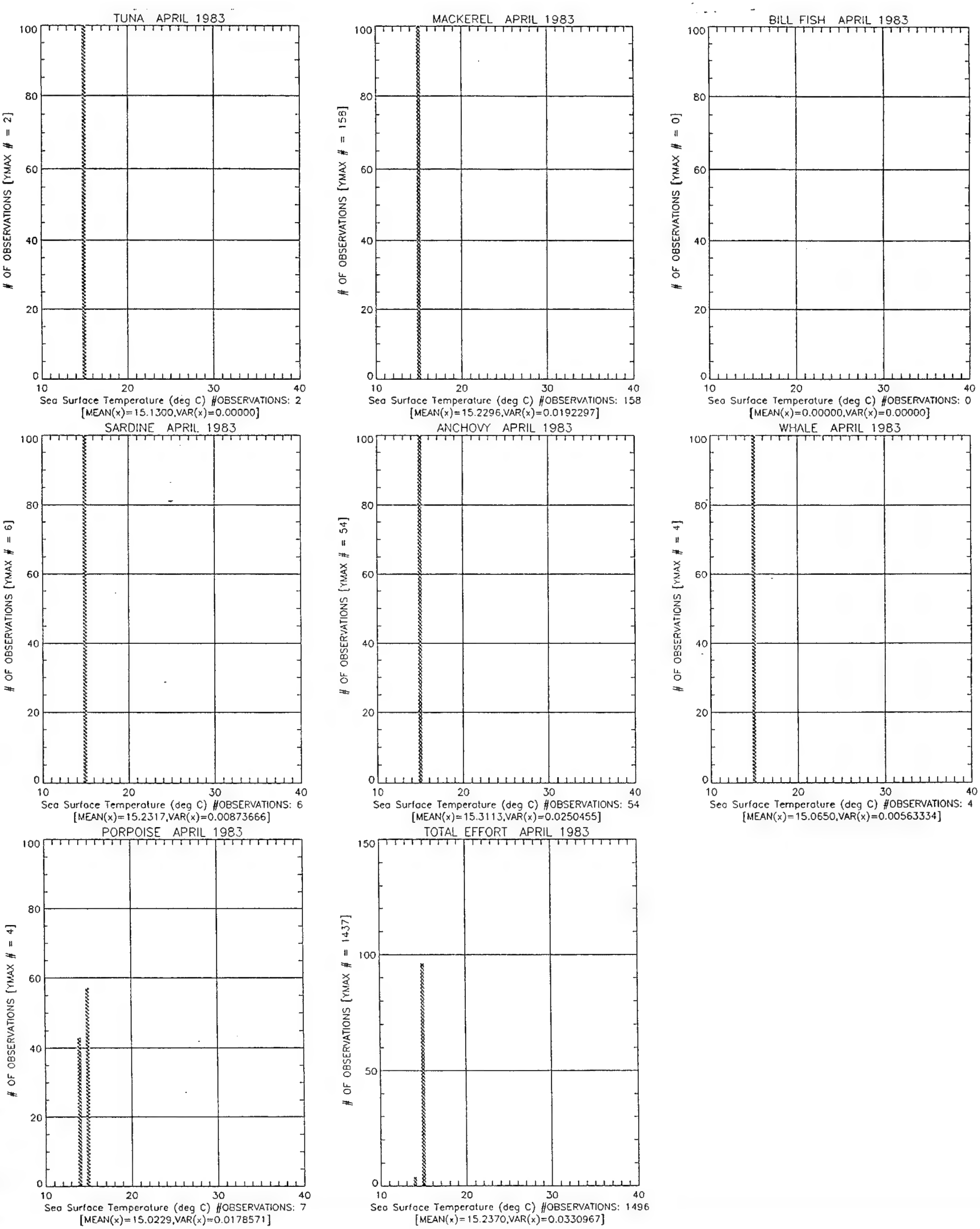
TUNA APRIL 1983
OF OBSERVATIONS [YMAX # = 2]
Mixed Layer Depth (meters) #OBSERVATIONS: 3
[MEAN(x)=6.66667,VAR(x)=33.3333]
MACKEREL APRIL 1983
OF OBSERVATIONS [YMAX # = 112]
Mixed Layer Depth (meters) #OBSERVATIONS: 159
[MEAN(x)=31.6730,VAR(x)=3721.25]
BILL FISH APRIL 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE APRIL 1983
OF OBSERVATIONS [YMAX # = 7]
Mixed Layer Depth (meters) #OBSERVATIONS: 7
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY APRIL 1983
OF OBSERVATIONS [YMAX # = 44]
Mixed Layer Depth (meters) #OBSERVATIONS: 55
[MEAN(x)=27.0909,VAR(x)=3542.53]
WHALE APRIL 1983
OF OBSERVATIONS [YMAX # = 3]
Mixed Layer Depth (meters) #OBSERVATIONS: 5
[MEAN(x)=68.8000,VAR(x)=8875.20]
PORPOISE APRIL 1983
OF OBSERVATIONS [YMAX # = 3]
Mixed Layer Depth (meters) #OBSERVATIONS: 8
[MEAN(x)=79.2500,VAR(x)=5393.07]
TOTAL EFFORT APRIL 1983
OF OBSERVATIONS [YMAX # = 975]
Mixed Layer Depth (meters) #OBSERVATIONS: 1497
[MEAN(x)=26.8290,VAR(x)=2621.22]

Figure 53



TUNA APRIL 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 2
[MEAN(x)=0.370000,VAR(x)=0.00000]
MACKEREL APRIL 1983
OF OBSERVATIONS [YMAX # = 75]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 158
[MEAN(x)=1.34127,VAR(x)=1.28513]
BILL FISH APRIL 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE APRIL 1983
OF OBSERVATIONS [YMAX # = 5]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 6
[MEAN(x)=1.01333,VAR(x)=1.42907]
ANCHOVY APRIL 1983
OF OBSERVATIONS [YMAX # = 23]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 54
[MEAN(x)=1.26333,VAR(x)=0.916272]
WHALE APRIL 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 4
[MEAN(x)=1.12000,VAR(x)=0.145200]
PORPOISE APRIL 1983
OF OBSERVATIONS [YMAX # = 4]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 7
[MEAN(x)=0.897143,VAR(x)=0.813824]
TOTAL EFFORT APRIL 1983
OF OBSERVATIONS [YMAX # = 720]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 1496
[MEAN(x)=1.25443,VAR(x)=1.11859]

Figure 54



TUNA APRIL 1983
OF OBSERVATIONS [YMAX # = 2]
Sea Surface Temperature (deg C) #OBSERVATIONS: 2
[MEAN(x)=15.1300,VAR(x)=0.00000]
MACKEREL APRIL 1983
OF OBSERVATIONS [YMAX # = 158]
Sea Surface Temperature (deg C) #OBSERVATIONS: 158
[MEAN(x)=15.2296,VAR(x)=0.0192297]
BILL FISH APRIL 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE APRIL 1983
OF OBSERVATIONS [YMAX # = 6]
Sea Surface Temperature (deg C) #OBSERVATIONS: 6
[MEAN(x)=15.2317,VAR(x)=0.00873666]
ANCHOVY APRIL 1983
OF OBSERVATIONS [YMAX # = 54]
Sea Surface Temperature (deg C) #OBSERVATIONS: 54
[MEAN(x)=15.3113,VAR(x)=0.0250455]
WHALE APRIL 1983
OF OBSERVATIONS [YMAX # = 4]
Sea Surface Temperature (deg C) #OBSERVATIONS: 4
[MEAN(x)=15.0650,VAR(x)=0.00563334]
PORPOISE APRIL 1983
OF OBSERVATIONS [YMAX # = 4]
Sea Surface Temperature (deg C) #OBSERVATIONS: 7
[MEAN(x)=15.0229,VAR(x)=0.0178571]
TOTAL EFFORT APRIL 1983
OF OBSERVATIONS [YMAX # = 1437]
Sea Surface Temperature (deg C) #OBSERVATIONS: 1496
[MEAN(x)=15.2370,VAR(x)=0.0330967]

Figure 55

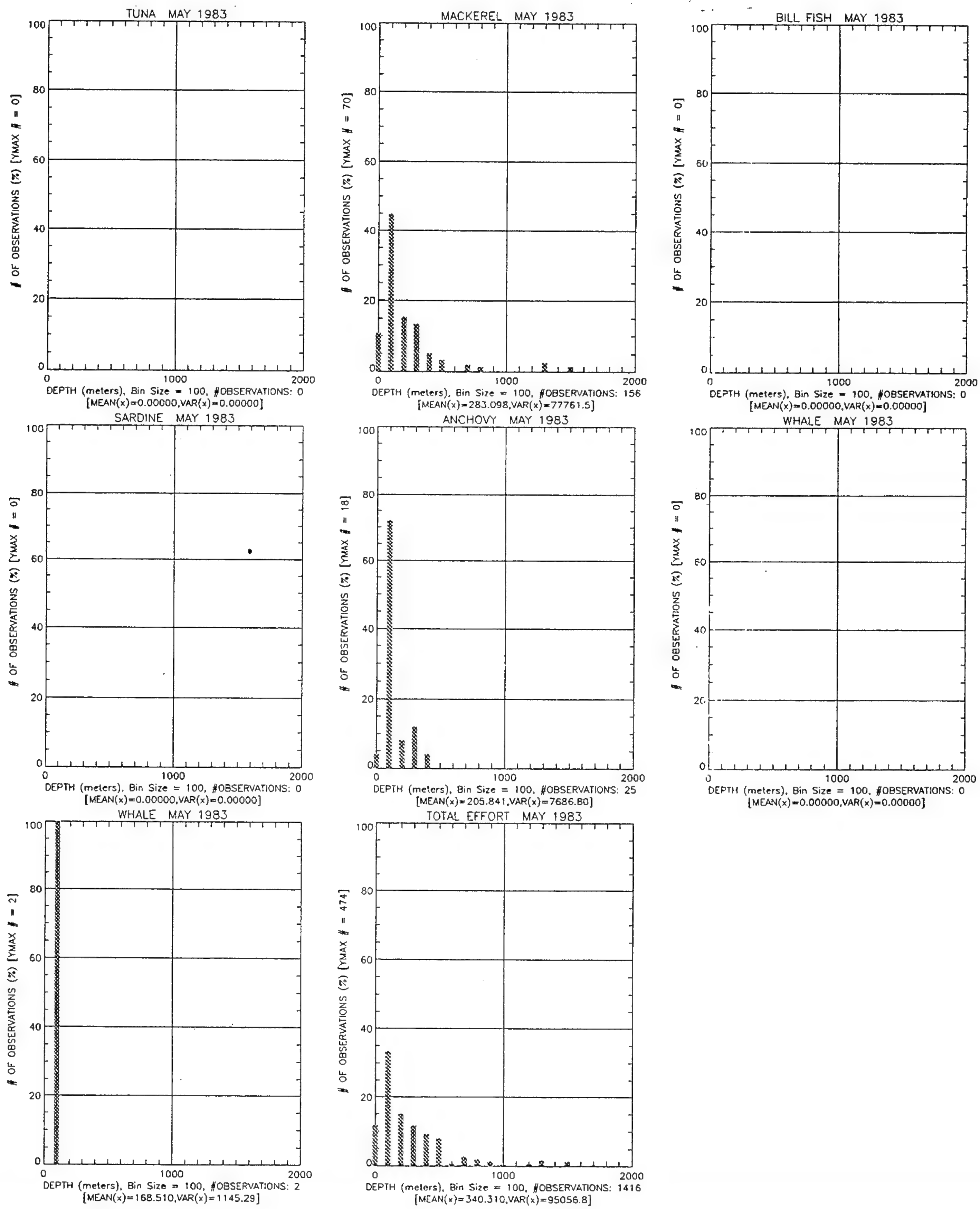
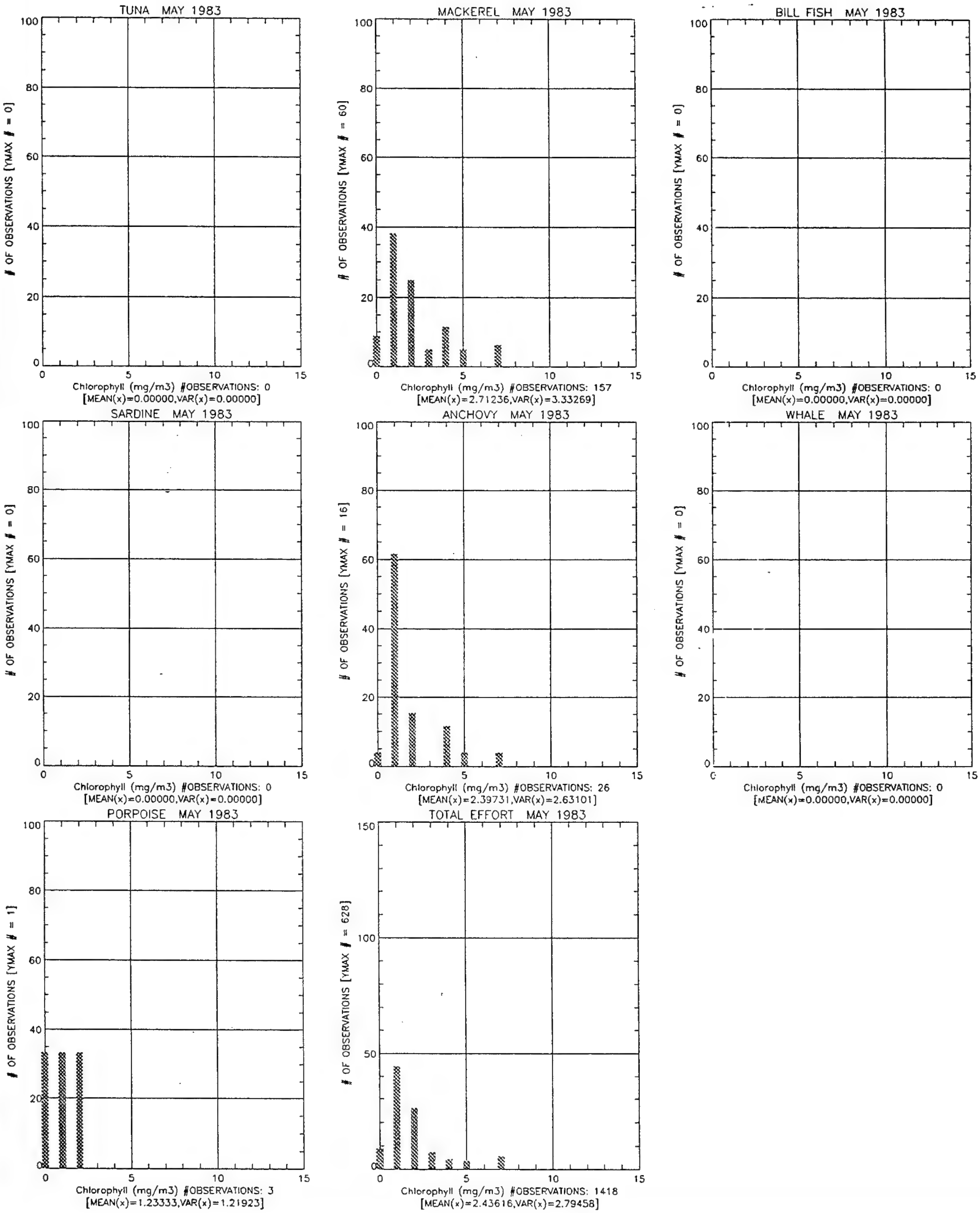

TUNA MAY 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL MAY 1983
OF OBSERVATIONS (%) [YMAX # = 70]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 156
[MEAN(x)=283.098,VAR(x)=77761.5]
BILL FISH MAY 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE MAY 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY MAY 1983
OF OBSERVATIONS (%) [YMAX # = 18]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 25
[MEAN(x)=205.841,VAR(x)=7686.80]
WHALE MAY 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE MAY 1983
OF OBSERVATIONS (%) [YMAX # = 2]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 2
[MEAN(x)=168.510,VAR(x)=1145.29]
TOTAL EFFORT MAY 1983
OF OBSERVATIONS (%) [YMAX # = 474]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 1416
[MEAN(x)=340.310,VAR(x)=95056.8]

Figure 56



TUNA MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL MAY 1983
OF OBSERVATIONS [YMAX # = 60]
Chlorophyll (mg/m3) #OBSERVATIONS: 157
[MEAN(x)=2.71236,VAR(x)=3.33269]
BILL FISH MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY MAY 1983
OF OBSERVATIONS [YMAX # = 16]
Chlorophyll (mg/m3) #OBSERVATIONS: 26
[MEAN(x)=2.39731,VAR(x)=2.63101]
WHALE MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE MAY 1983
OF OBSERVATIONS [YMAX # = 1]
Chlorophyll (mg/m3) #OBSERVATIONS: 3
[MEAN(x)=1.23333,VAR(x)=1.21923]
TOTAL EFFORT MAY 1983
OF OBSERVATIONS [YMAX # = 628]
Chlorophyll (mg/m3) #OBSERVATIONS: 1418
[MEAN(x)=2.43616,VAR(x)=2.79458]

Figure 57

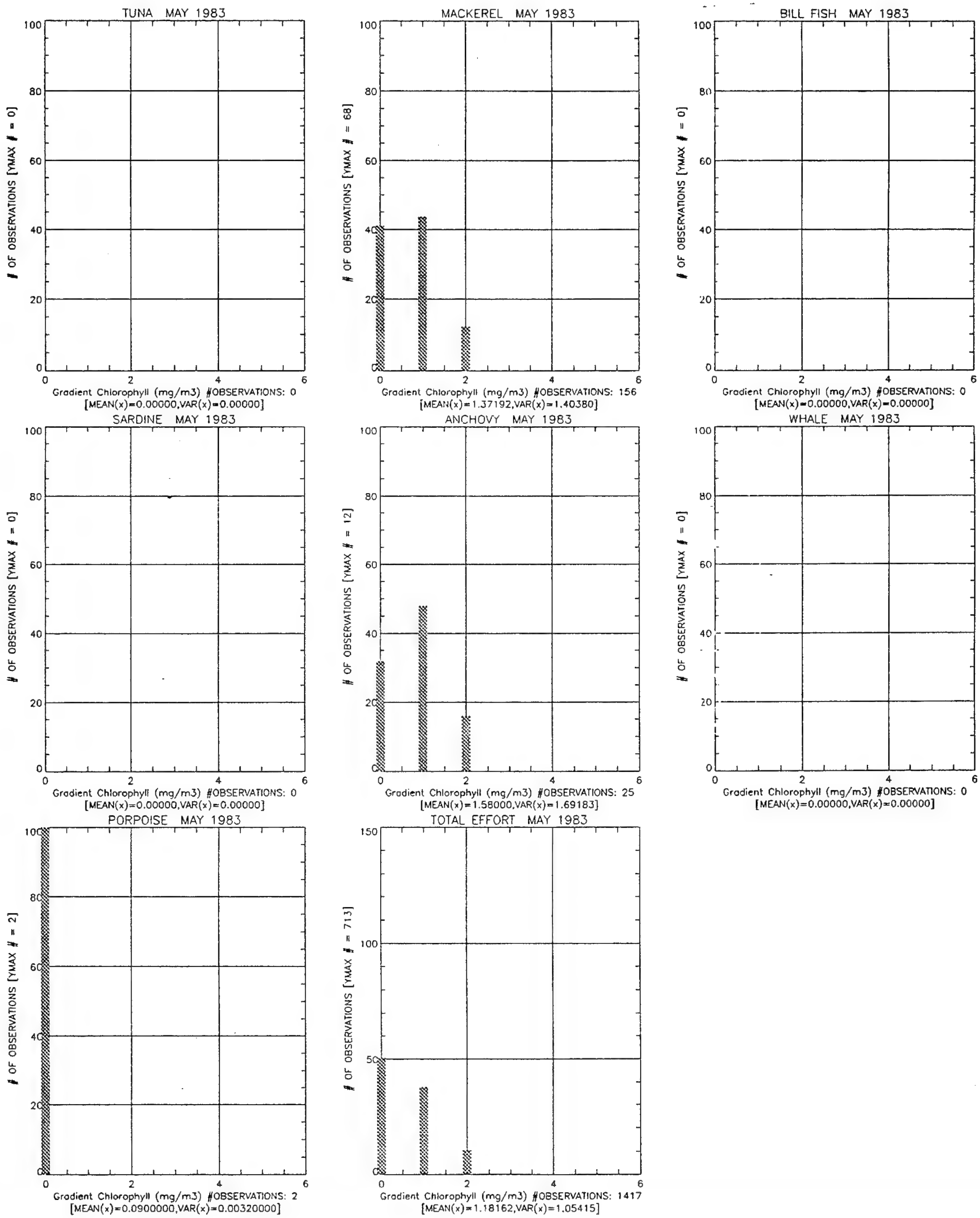
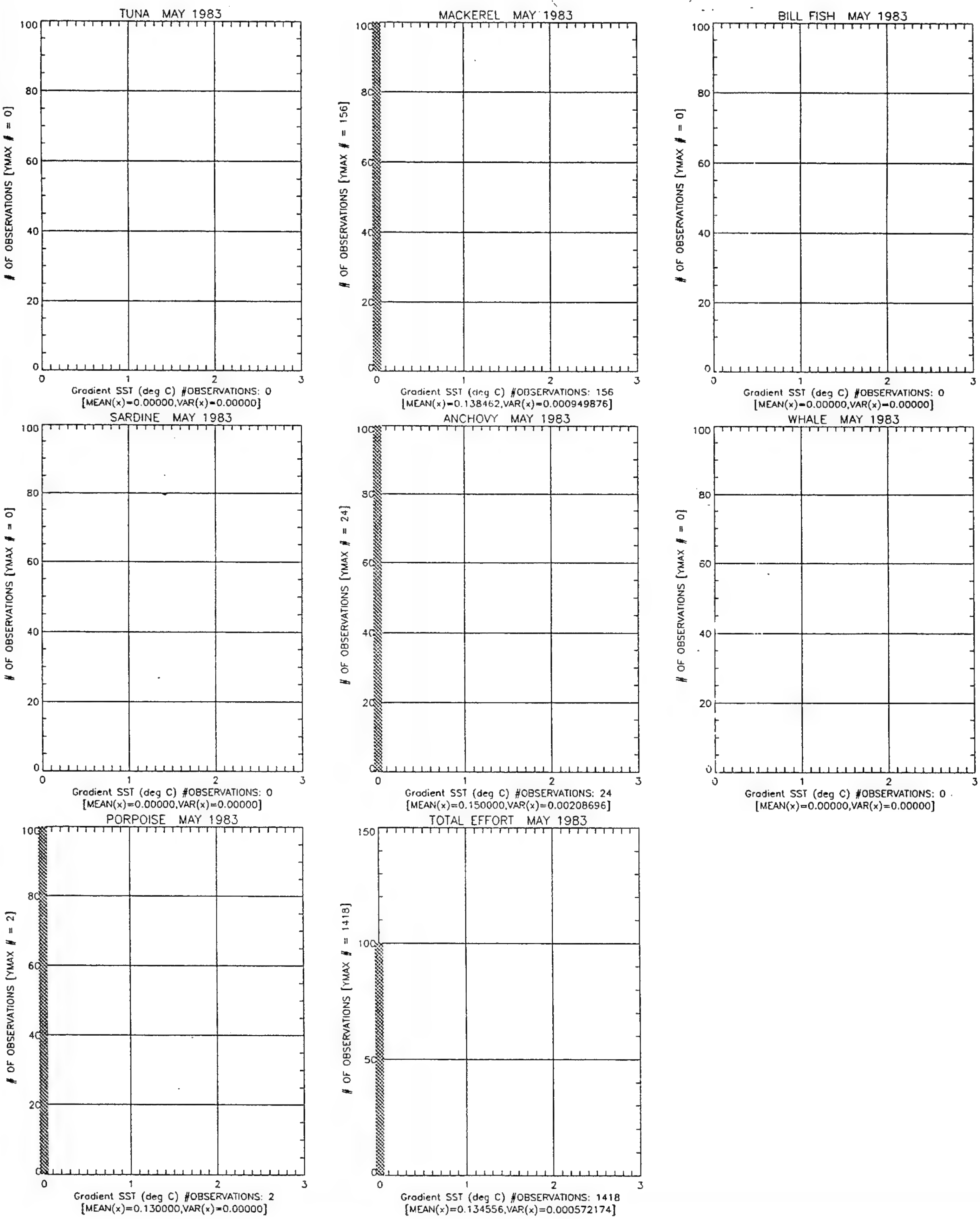

TUNA MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL MAY 1983
OF OBSERVATIONS [YMAX # = 68]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 156
[MEAN(x)=1.37192,VAR(x)=1.40380]
BILL FISH MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY MAY 1983
OF OBSERVATIONS [YMAX # = 12]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 25
[MEAN(x)=1.58000,VAR(x)=1.69183]
WHALE MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE MAY 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 2
[MEAN(x)=0.0900000,VAR(x)=0.00320000]
TOTAL EFFORT MAY 1983
OF OBSERVATIONS [YMAX # = 713]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 1417
[MEAN(x)=1.18162,VAR(x)=1.05415]

Figure 58



TUNA MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL MAY 1983
OF OBSERVATIONS [YMAX # = 156]
Gradient SST (deg C) #OBSERVATIONS: 156
[MEAN(x)=0.138462,VAR(x)=0.000949876]
BILL FISH MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY MAY 1983
OF OBSERVATIONS [YMAX # = 24]
Gradient SST (deg C) #OBSERVATIONS: 24
[MEAN(x)=0.150000,VAR(x)=0.00208696]
WHALE MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE MAY 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient SST (deg C) #OBSERVATIONS: 2
[MEAN(x)=0.130000,VAR(x)=0.00000]
TOTAL EFFORT MAY 1983
OF OBSERVATIONS [YMAX # = 1418]
Gradient SST (deg C) #OBSERVATIONS: 1418
[MEAN(x)=0.134556,VAR(x)=0.000572174]

Figure 59

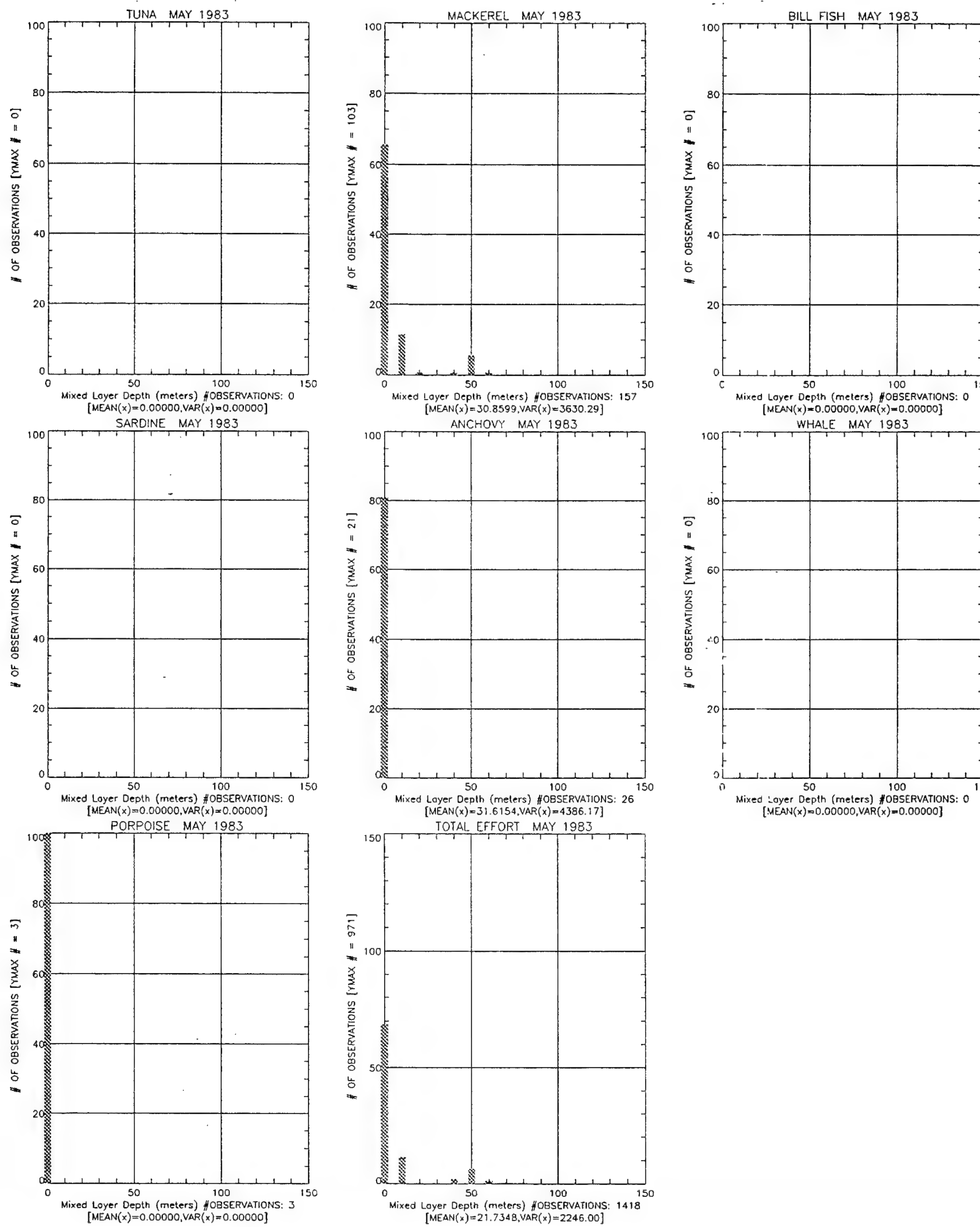
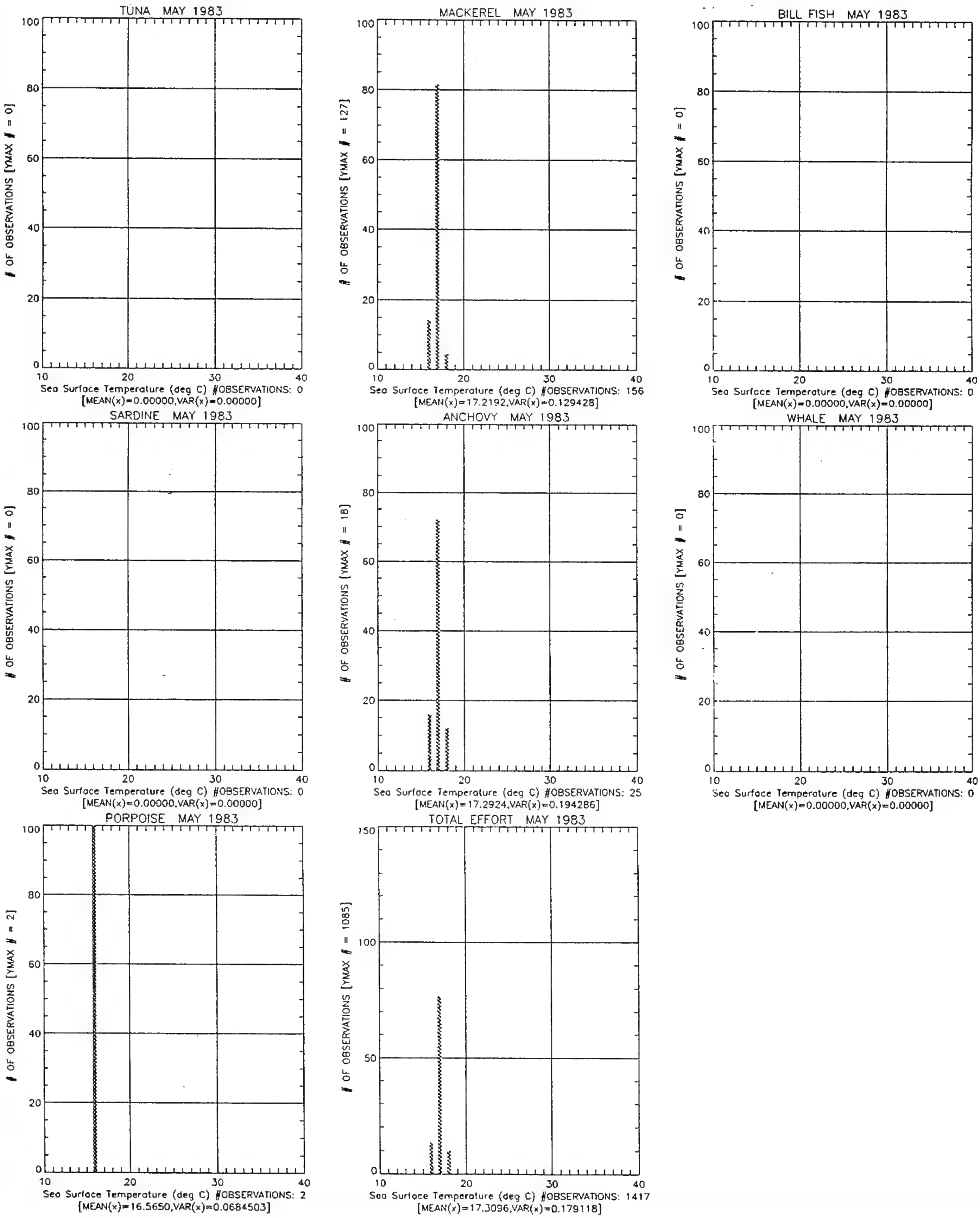

TUNA MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL MAY 1983
OF OBSERVATIONS [YMAX # = 103]
Mixed Layer Depth (meters) #OBSERVATIONS: 157
[MEAN(x)=30.8599,VAR(x)=3630.29]
BILL FISH MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY MAY 1983
OF OBSERVATIONS [YMAX # = 21]
Mixed Layer Depth (meters) #OBSERVATIONS: 26
[MEAN(x)=31.6154,VAR(x)=4386.17]
WHALE MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE MAY 1983
OF OBSERVATIONS [YMAX # = 3]
Mixed Layer Depth (meters) #OBSERVATIONS: 3
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT MAY 1983
OF OBSERVATIONS [YMAX # = 971]
Mixed Layer Depth (meters) #OBSERVATIONS: 1418
[MEAN(x)=21.7348,VAR(x)=2246.00]

Figure 60



TUNA MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL MAY 1983
OF OBSERVATIONS [YMAX # = 127]
Sea Surface Temperature (deg C) #OBSERVATIONS: 156
[MEAN(x)=17.2192,VAR(x)=0.129428]
BILL FISH MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY MAY 1983
OF OBSERVATIONS [YMAX # = 18]
Sea Surface Temperature (deg C) #OBSERVATIONS: 25
[MEAN(x)=17.2924,VAR(x)=0.194286]
WHALE MAY 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE MAY 1983
OF OBSERVATIONS [YMAX # = 2]
Sea Surface Temperature (deg C) #OBSERVATIONS: 2
[MEAN(x)=16.5650,VAR(x)=0.0684503]
TOTAL EFFORT MAY 1983
OF OBSERVATIONS [YMAX # = 1085]
Sea Surface Temperature (deg C) #OBSERVATIONS: 1417
[MEAN(x)=17.3096,VAR(x)=0.179118]

Figure 61

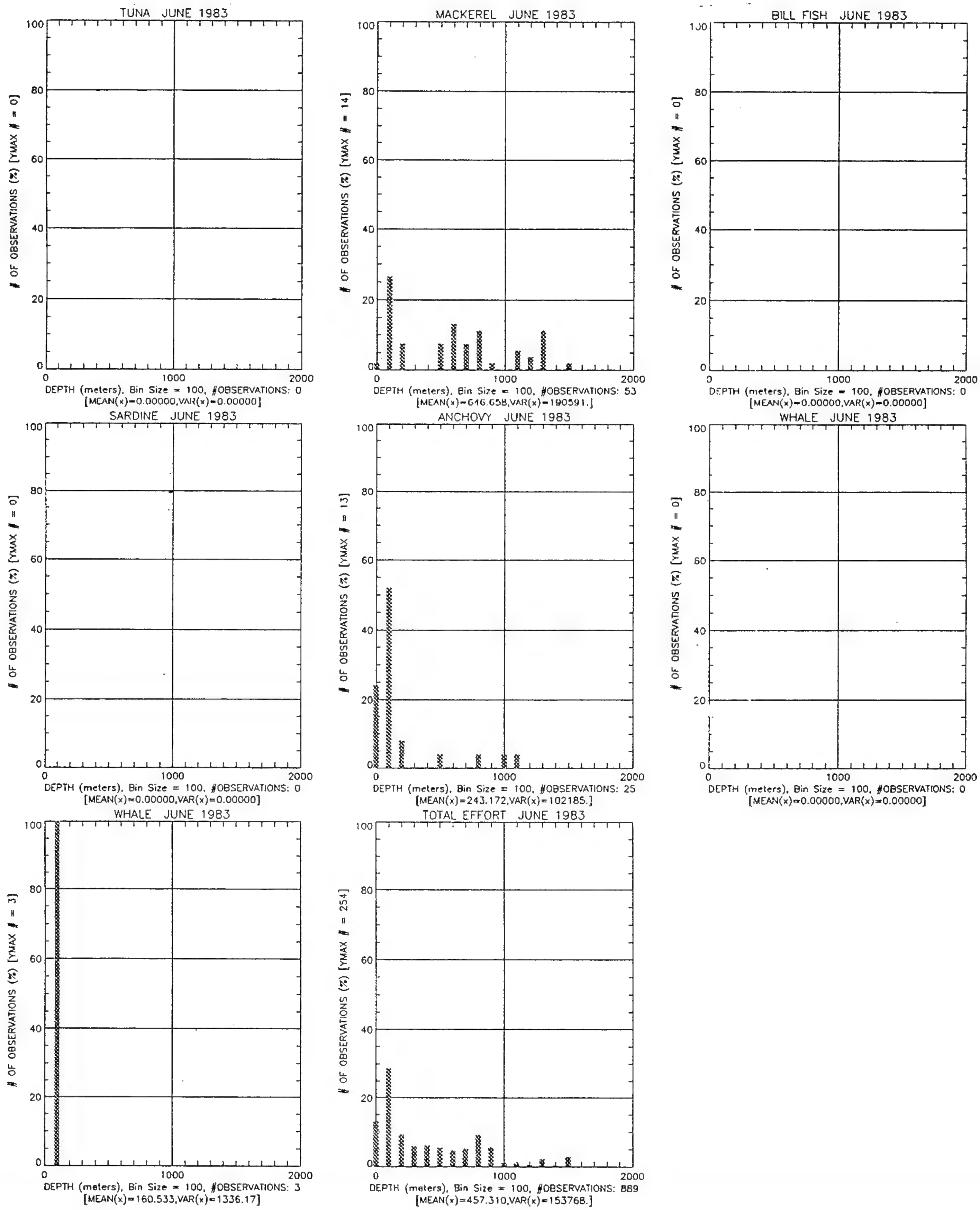
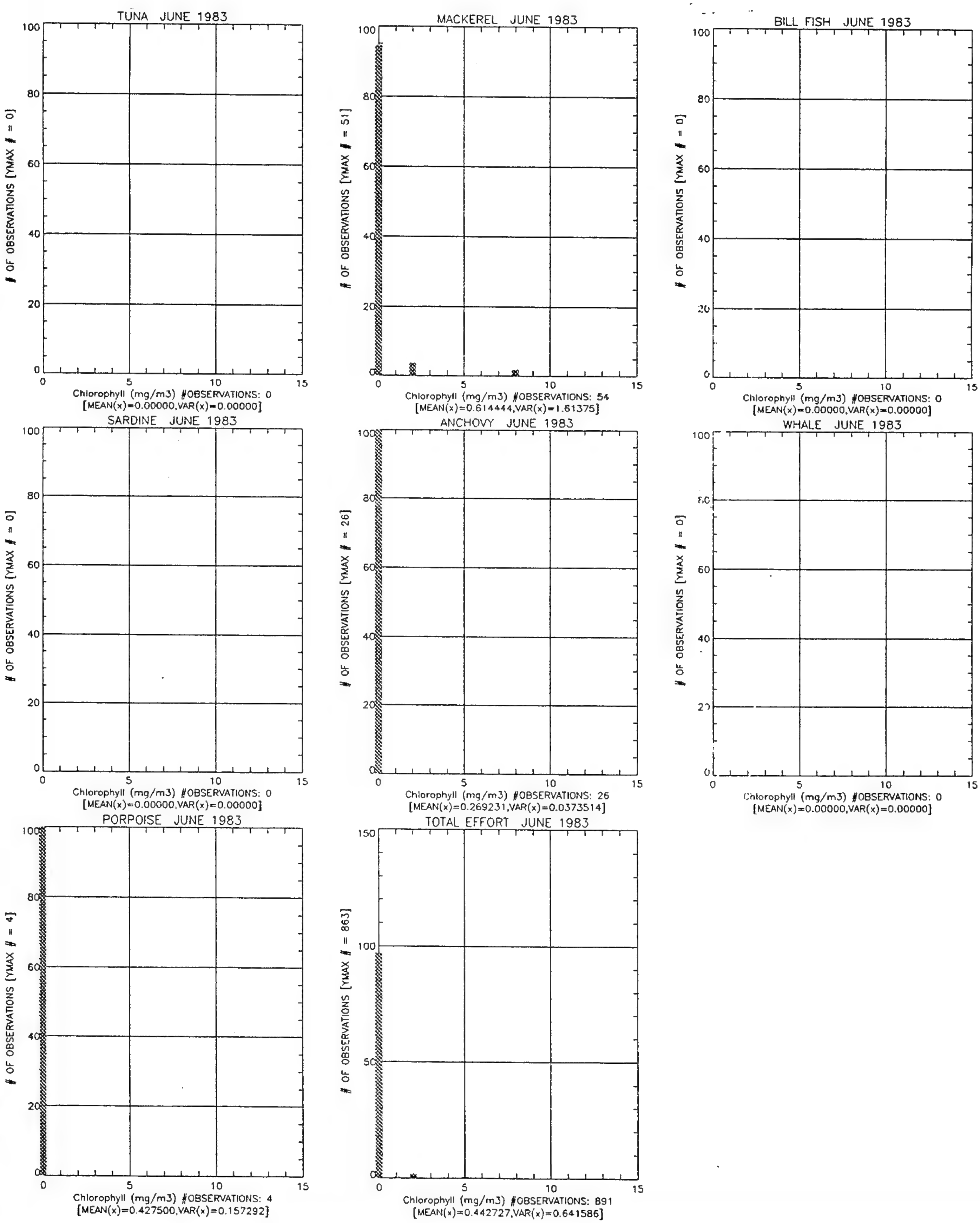

TUNA JUNE 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL JUNE 1983
OF OBSERVATIONS (%) [YMAX # = 14]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 53
[MEAN(x)=646.658,VAR(x)=190591.]
BILL FISH JUNE 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE JUNE 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY JUNE 1983
OF OBSERVATIONS (%) [YMAX # = 13]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 25
[MEAN(x)=243.172,VAR(x)=102185.]
WHALE JUNE 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE JUNE 1983
OF OBSERVATIONS (%) [YMAX # = 3]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 3
[MEAN(x)=160.533,VAR(x)=1336.17]
TOTAL EFFORT JUNE 1983
OF OBSERVATIONS (%) [YMAX # = 254]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 889
[MEAN(x)=457.310,VAR(x)=153768.]

Figure 62



TUNA JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL JUNE 1983
OF OBSERVATIONS [YMAX # = 51]
Chlorophyll (mg/m3) #OBSERVATIONS: 54
[MEAN(x)=0.614444,VAR(x)=1.61375]
BILL FISH JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY JUNE 1983
OF OBSERVATIONS [YMAX # = 26]
Chlorophyll (mg/m3) #OBSERVATIONS: 26
[MEAN(x)=0.269231,VAR(x)=0.0373514]
WHALE JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE JUNE 1983
OF OBSERVATIONS [YMAX # = 4]
Chlorophyll (mg/m3) #OBSERVATIONS: 4
[MEAN(x)=0.427500,VAR(x)=0.157292]
TOTAL EFFORT JUNE 1983
OF OBSERVATIONS [YMAX # = 863]
Chlorophyll (mg/m3) #OBSERVATIONS: 891
[MEAN(x)=0.442727,VAR(x)=0.641586]

Figure 63

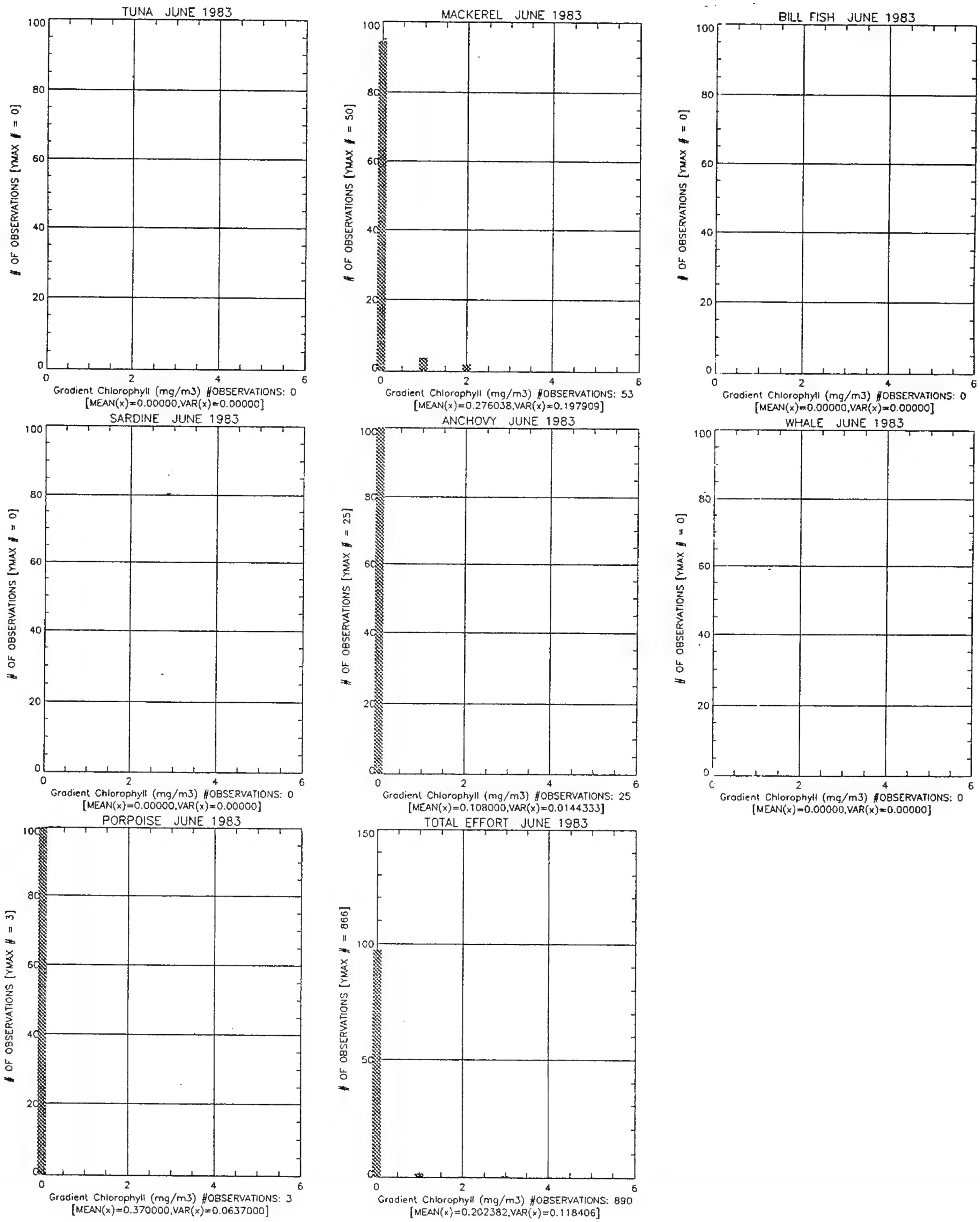

TUNA JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL JUNE 1983
OF OBSERVATIONS [YMAX # = 50]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 53
[MEAN(x)=0.276038,VAR(x)=0.197909]
BILL FISH JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY JUNE 1983
OF OBSERVATIONS [YMAX # = 25]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 25
[MEAN(x)=0.108000,VAR(x)=0.0144333]
WHALE JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE JUNE 1983
OF OBSERVATIONS [YMAX # = 3]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 3
[MEAN(x)=0.370000,VAR(x)=0.0637000]
TOTAL EFFORT JUNE 1983
OF OBSERVATIONS [YMAX # = 866]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 890
[MEAN(x)=0.202382,VAR(x)=0.118406]

Figure 64

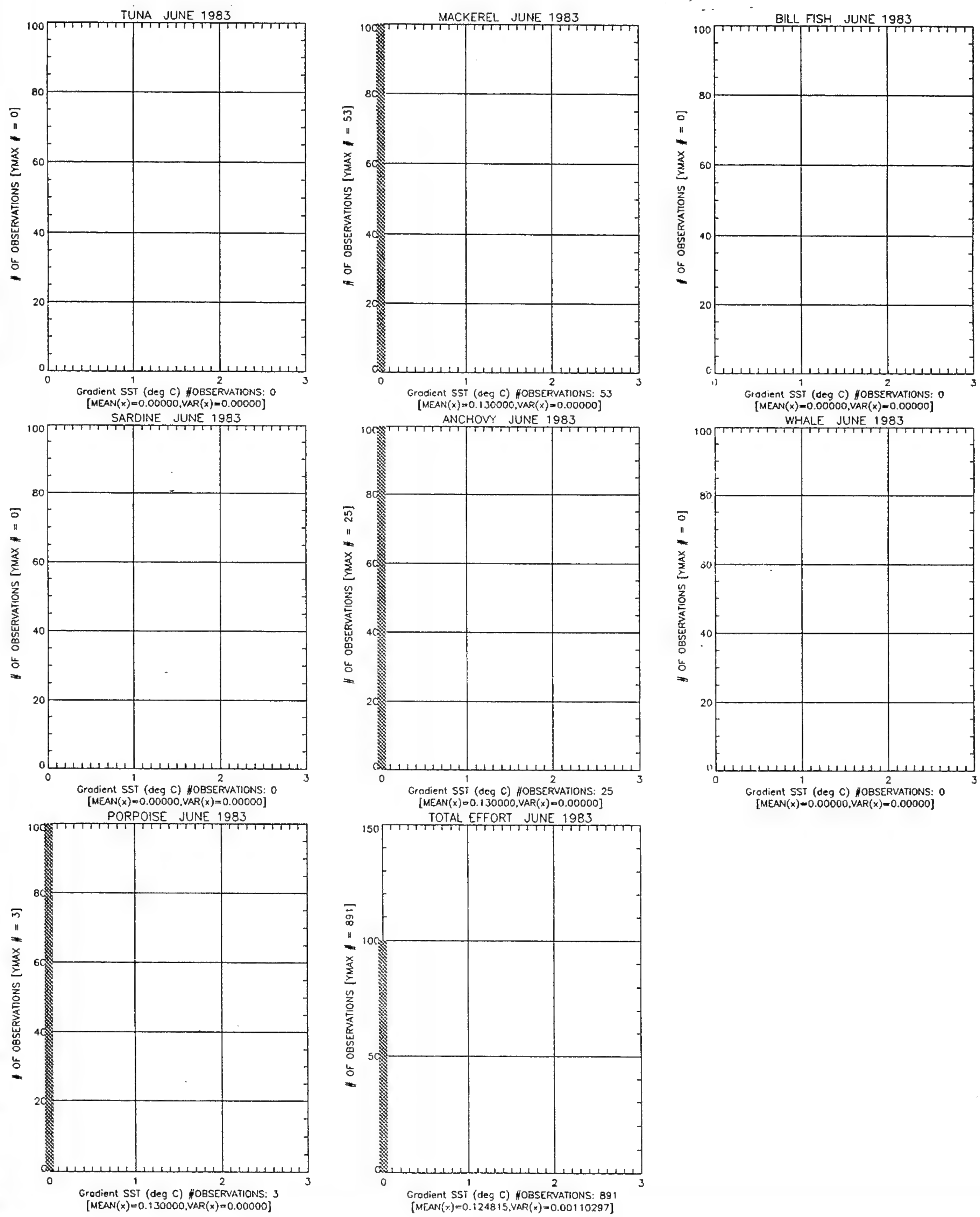

TUNA JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL JUNE 1983
OF OBSERVATIONS [YMAX # = 53]
Gradient SST (deg C) #OBSERVATIONS: 53
[MEAN(x)=0.130000,VAR(x)=0.00000]
BILL FISH JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY JUNE 1983
OF OBSERVATIONS [YMAX # = 25]
Gradient SST (deg C) #OBSERVATIONS: 25
[MEAN(x)=0.130000,VAR(x)=0.00000]
WHALE JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE JUNE 1983
OF OBSERVATIONS [YMAX # = 3]
Gradient SST (deg C) #OBSERVATIONS: 3
[MEAN(x)=0.130000,VAR(x)=0.00000]
TOTAL EFFORT JUNE 1983
OF OBSERVATIONS [YMAX # = 891]
Gradient SST (deg C) #OBSERVATIONS: 891
[MEAN(x)=0.124815,VAR(x)=0.00110297]

Figure 65

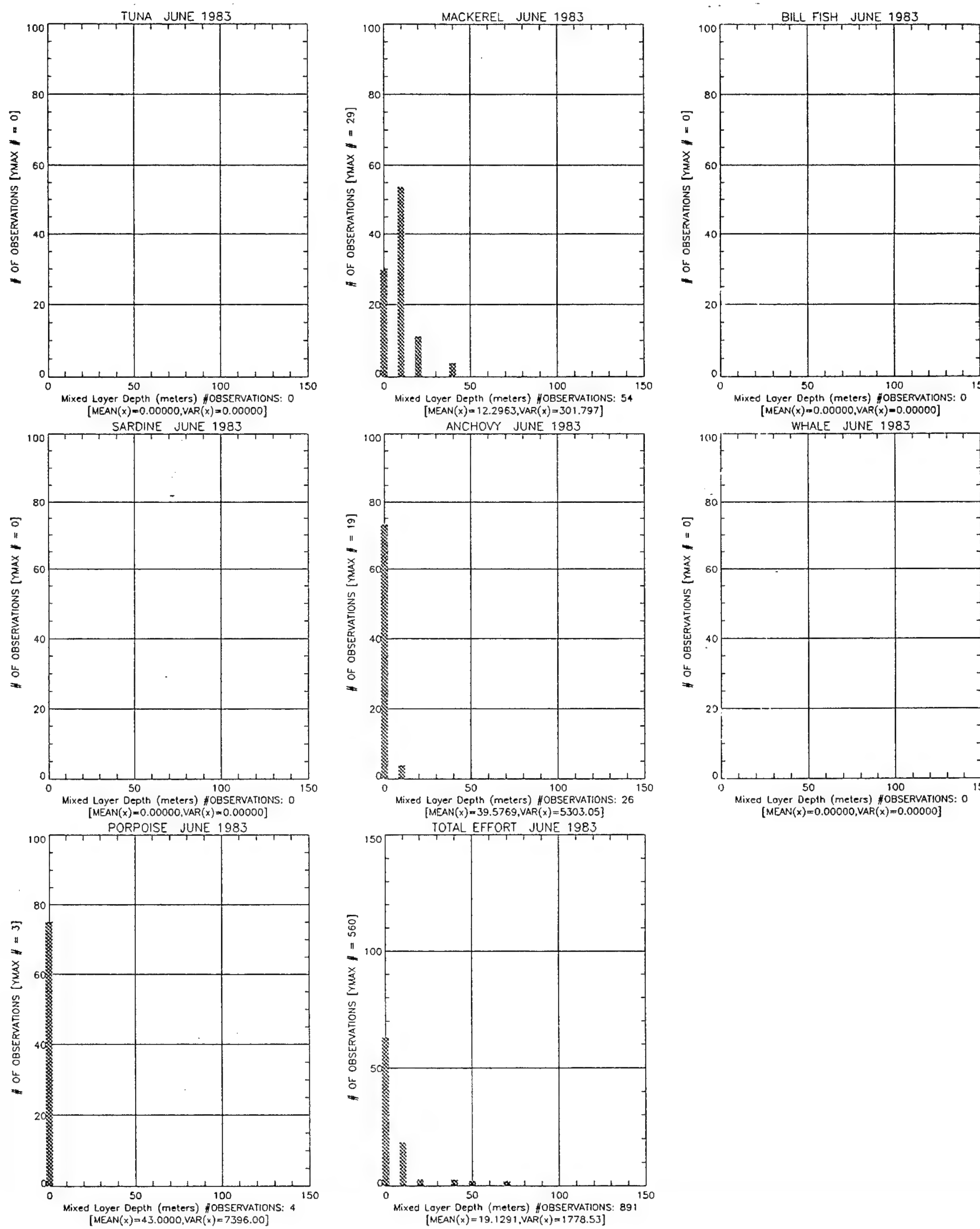
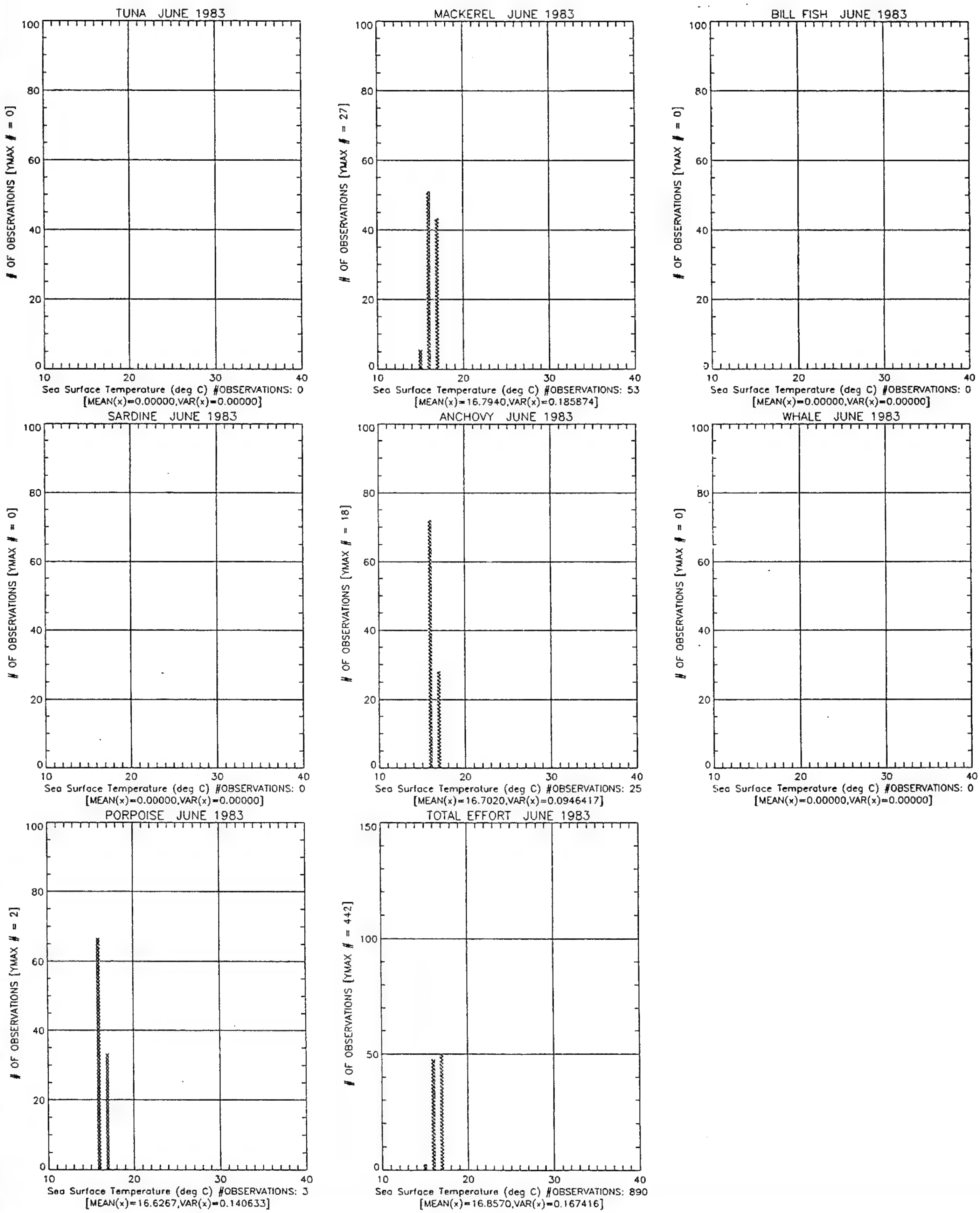

TUNA JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL JUNE 1983
OF OBSERVATIONS [YMAX # = 29]
Mixed Layer Depth (meters) #OBSERVATIONS: 54
[MEAN(x)=12.2963,VAR(x)=301.797]
BILL FISH JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY JUNE 1983
OF OBSERVATIONS [YMAX # = 19]
Mixed Layer Depth (meters) #OBSERVATIONS: 26
[MEAN(x)=39.5769,VAR(x)=5303.05]
WHALE JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE JUNE 1983
OF OBSERVATIONS [YMAX # = 3]
Mixed Layer Depth (meters) #OBSERVATIONS: 4
[MEAN(x)=43.0000,VAR(x)=7396.00]
TOTAL EFFORT JUNE 1983
OF OBSERVATIONS [YMAX # = 560]
Mixed Layer Depth (meters) #OBSERVATIONS: 891
[MEAN(x)=19.1291,VAR(x)=1778.53]

Figure 66



TUNA JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL JUNE 1983
OF OBSERVATIONS [YMAX # = 27]
Sea Surface Temperature (deg C) #OBSERVATIONS: 53
[MEAN(x)=16.7940,VAR(x)=0.185874]
BILL FISH JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY JUNE 1983
OF OBSERVATIONS [YMAX # = 18]
Sea Surface Temperature (deg C) #OBSERVATIONS: 25
[MEAN(x)=16.7020,VAR(x)=0.0946417]
WHALE JUNE 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE JUNE 1983
OF OBSERVATIONS [YMAX # = 2]
Sea Surface Temperature (deg C) #OBSERVATIONS: 3
[MEAN(x)=16.6267,VAR(x)=0.140633]
TOTAL EFFORT JUNE 1983
OF OBSERVATIONS [YMAX # = 442]
Sea Surface Temperature (deg C) #OBSERVATIONS: 890
[MEAN(x)=16.8570,VAR(x)=0.167416]

Figure 67

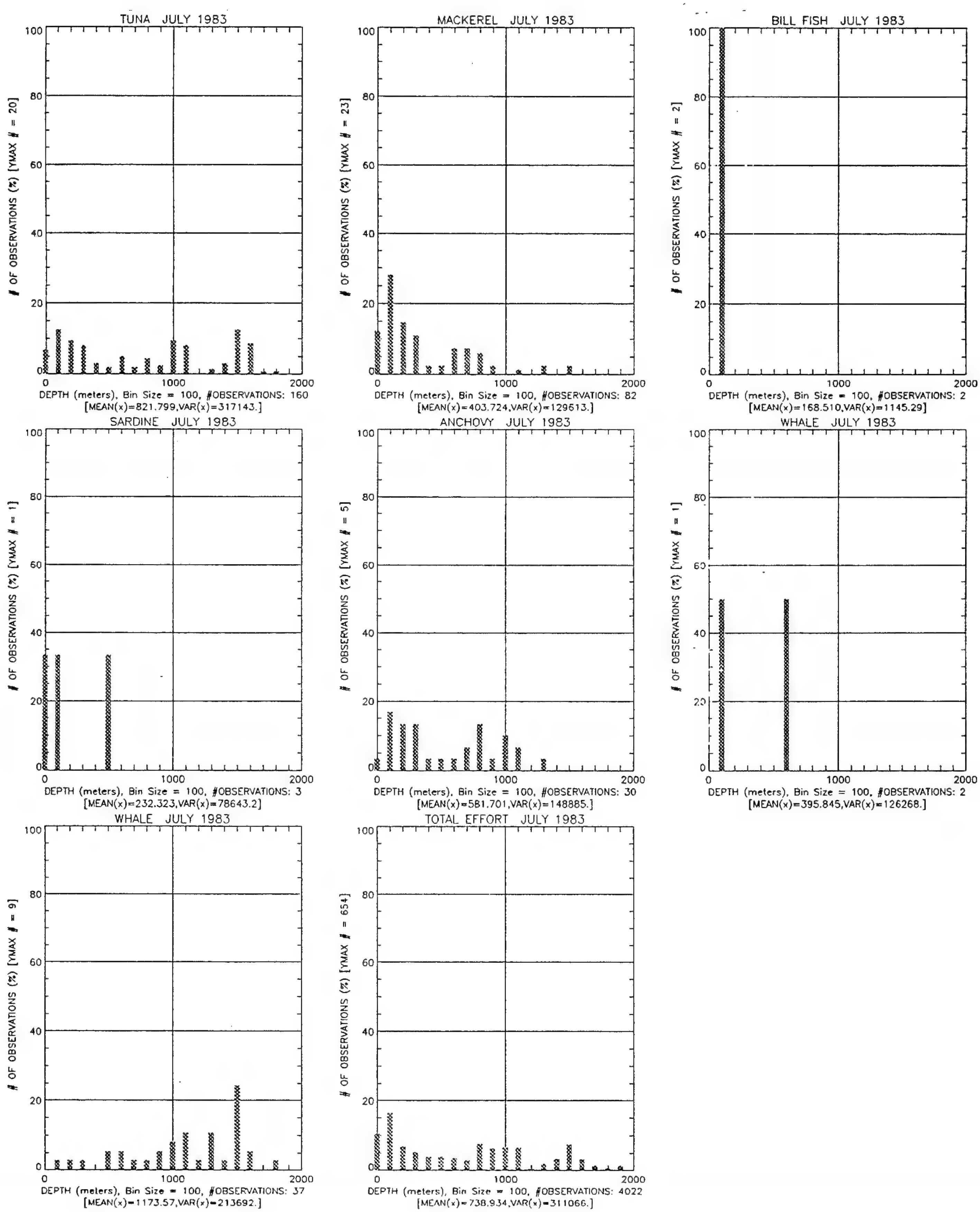
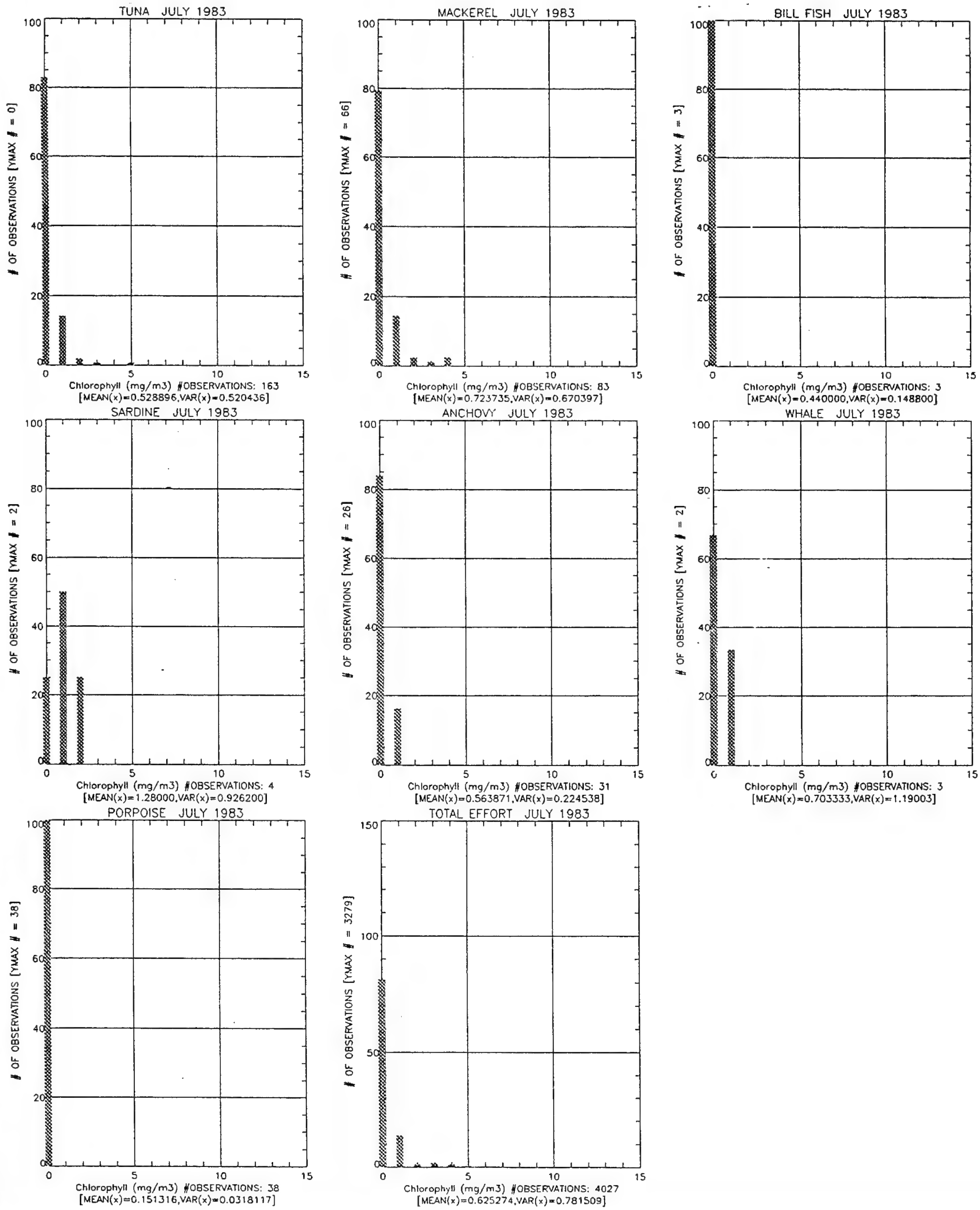

TUNA JULY 1983
OF OBSERVATIONS (%) [YMAX # = 20]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 160
[MEAN(x)=821.799,VAR(x)=317143.]
MACKEREL JULY 1983
OF OBSERVATIONS (%) [YMAX # = 23]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 82
[MEAN(x)=403.724,VAR(x)=129613.]
BILL FISH JULY 1983
OF OBSERVATIONS (%) [YMAX # = 2]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 2
[MEAN(x)=168.510,VAR(x)=1145.29]
SARDINE JULY 1983
OF OBSERVATIONS (%) [YMAX # = 1]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 3
[MEAN(x)=232.323,VAR(x)=78643.2]
ANCHOVY JULY 1983
OF OBSERVATIONS (%) [YMAX # = 5]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 30
[MEAN(x)=581.701,VAR(x)=148885.]
WHALE JULY 1983
OF OBSERVATIONS (%) [YMAX # = 1]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 2
[MEAN(x)=395.845,VAR(x)=126268.]
WHALE JULY 1983
OF OBSERVATIONS (%) [YMAX # = 9]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 37
[MEAN(x)=1173.57,VAR(x)=213692.]
TOTAL EFFORT JULY 1983
OF OBSERVATIONS (%) [YMAX # = 654]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 4022
[MEAN(x)=738.934,VAR(x)=311066.]

Figure 68



TUNA JULY 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 163
[MEAN(x)=0.528896,VAR(x)=0.520436]
MACKEREL JULY 1983
OF OBSERVATIONS [YMAX # = 66]
Chlorophyll (mg/m3) #OBSERVATIONS: 83
[MEAN(x)=0.723735,VAR(x)=0.670397]
BILL FISH JULY 1983
OF OBSERVATIONS [YMAX # = 3]
Chlorophyll (mg/m3) #OBSERVATIONS: 3
[MEAN(x)=0.440000,VAR(x)=0.148800]
SARDINE JULY 1983
OF OBSERVATIONS [YMAX # = 2]
Chlorophyll (mg/m3) #OBSERVATIONS: 4
[MEAN(x)=1.28000,VAR(x)=0.926200]
ANCHOVY JULY 1983
OF OBSERVATIONS [YMAX # = 26]
Chlorophyll (mg/m3) #OBSERVATIONS: 31
[MEAN(x)=0.563871,VAR(x)=0.224538]
WHALE JULY 1983
OF OBSERVATIONS [YMAX # = 2]
Chlorophyll (mg/m3) #OBSERVATIONS: 3
[MEAN(x)=0.703333,VAR(x)=1.19003]
PORPOISE JULY 1983
OF OBSERVATIONS [YMAX # = 38]
Chlorophyll (mg/m3) #OBSERVATIONS: 38
[MEAN(x)=0.151316,VAR(x)=0.0318117]
TOTAL EFFORT JULY 1983
OF OBSERVATIONS [YMAX # = 3279]
Chlorophyll (mg/m3) #OBSERVATIONS: 4027
[MEAN(x)=0.625274,VAR(x)=0.781509]

Figure 69

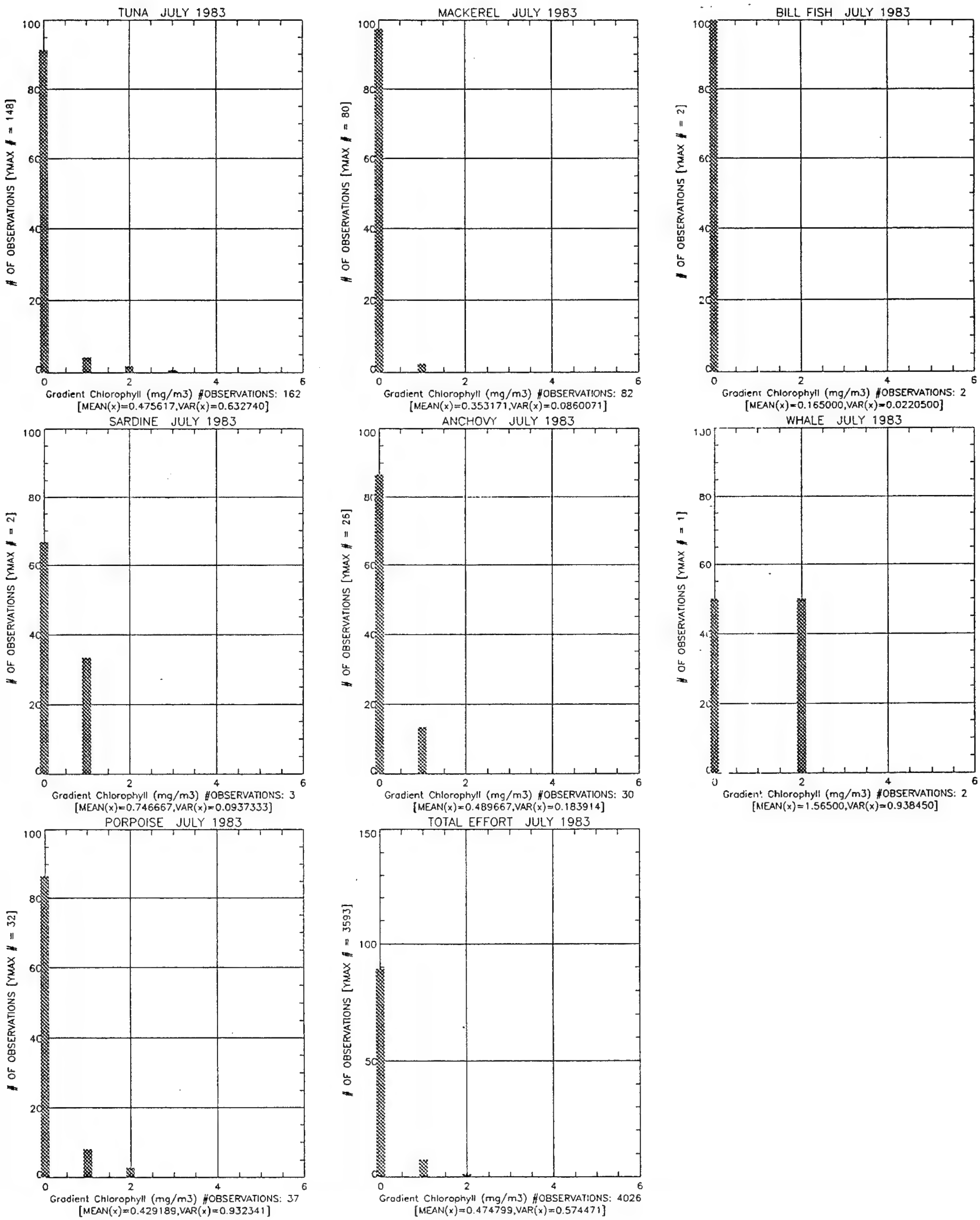
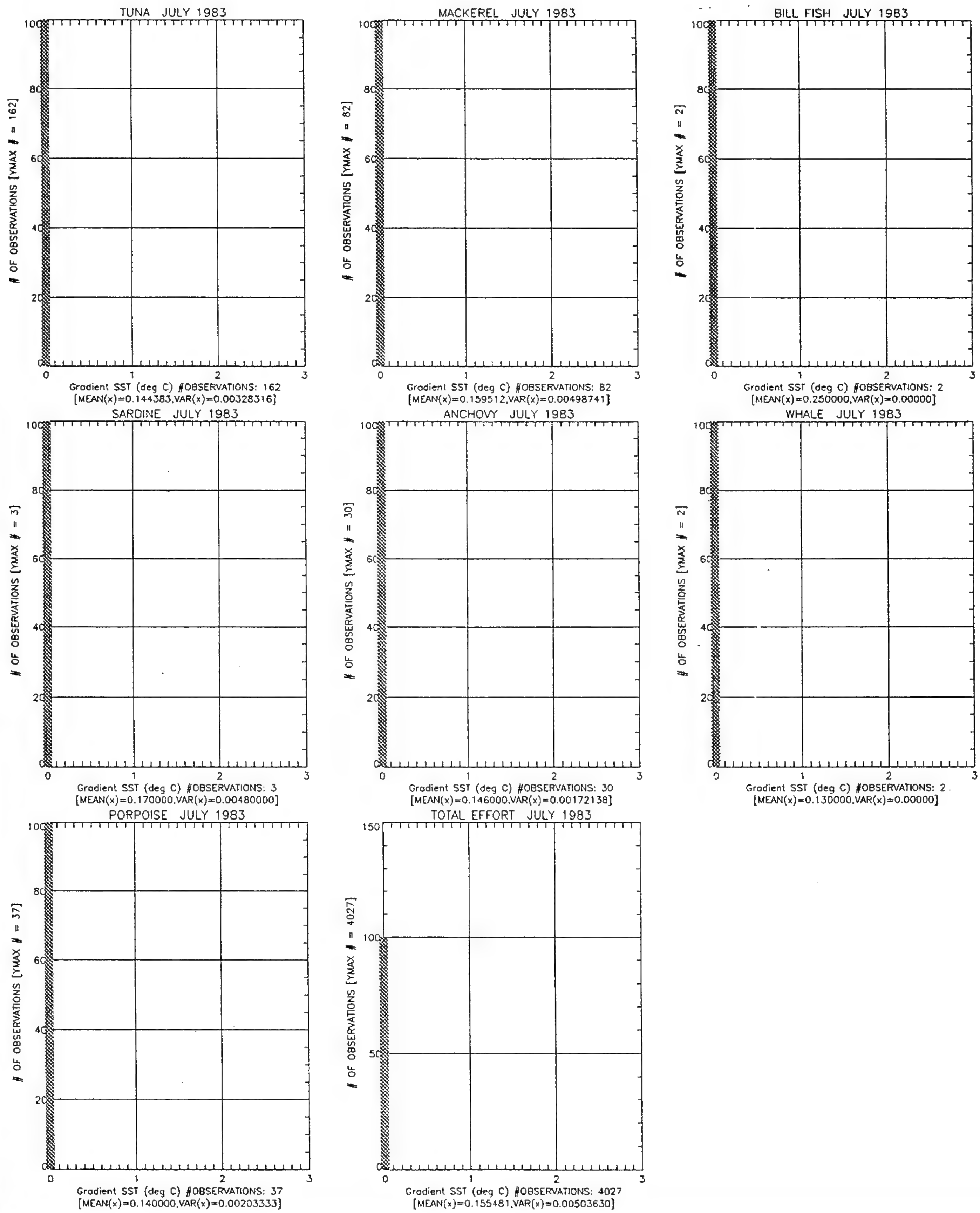

TUNA JULY 1983
OF OBSERVATIONS [YMAX # = 148]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 162
[MEAN(x)=0.475617,VAR(x)=0.632740]
MACKEREL JULY 1983
OF OBSERVATIONS [YMAX # = 80]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 82
[MEAN(x)=0.353171,VAR(x)=0.0860071]
BILL FISH JULY 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 2
[MEAN(x)=0.165000,VAR(x)=0.0220500]
SARDINE JULY 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 3
[MEAN(x)=0.746667,VAR(x)=0.0937333]
ANCHOVY JULY 1983
OF OBSERVATIONS [YMAX # = 26]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 30
[MEAN(x)=0.489667,VAR(x)=0.183914]
WHALE JULY 1983
OF OBSERVATIONS [YMAX # = 1]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 2
[MEAN(x)=1.56500,VAR(x)=0.938450]
PORPOISE JULY 1983
OF OBSERVATIONS [YMAX # = 32]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 37
[MEAN(x)=0.429189,VAR(x)=0.932341]
TOTAL EFFORT JULY 1983
OF OBSERVATIONS [YMAX # = 3593]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 4026
[MEAN(x)=0.474799,VAR(x)=0.574471]

Figure 70



TUNA JULY 1983
OF OBSERVATIONS [YMAX # = 162]
Gradient SST (deg C) #OBSERVATIONS: 162
[MEAN(x)=0.144383,VAR(x)=0.00328316]
MACKEREL JULY 1983
OF OBSERVATIONS [YMAX # = 82]
Gradient SST (deg C) #OBSERVATIONS: 82
[MEAN(x)=0.159512,VAR(x)=0.00498741]
BILL FISH JULY 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient SST (deg C) #OBSERVATIONS: 2
[MEAN(x)=0.250000,VAR(x)=0.00000]
SARDINE JULY 1983
OF OBSERVATIONS [YMAX # = 3]
Gradient SST (deg C) #OBSERVATIONS: 3
[MEAN(x)=0.170000,VAR(x)=0.00480000]
ANCHOVY JULY 1983
OF OBSERVATIONS [YMAX # = 30]
Gradient SST (deg C) #OBSERVATIONS: 30
[MEAN(x)=0.146000,VAR(x)=0.00172138]
WHALE JULY 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient SST (deg C) #OBSERVATIONS: 2
[MEAN(x)=0.130000,VAR(x)=0.00000]
PORPOISE JULY 1983
OF OBSERVATIONS [YMAX # = 37]
Gradient SST (deg C) #OBSERVATIONS: 37
[MEAN(x)=0.140000,VAR(x)=0.00203333]
TOTAL EFFORT JULY 1983
OF OBSERVATIONS [YMAX # = 4027]
Gradient SST (deg C) #OBSERVATIONS: 4027
[MEAN(x)=0.155481,VAR(x)=0.00503630]

Figure 71

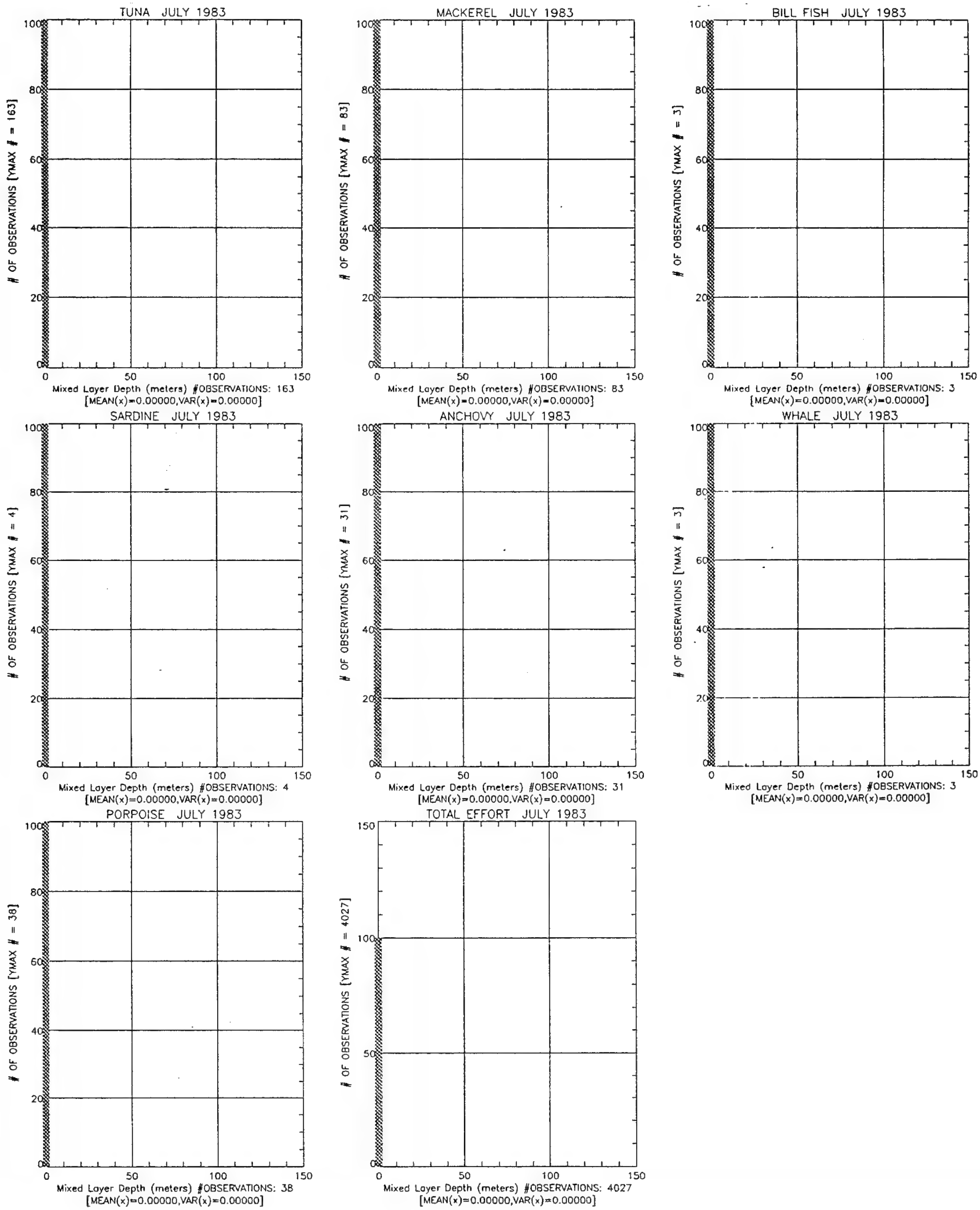

TUNA JULY 1983
OF OBSERVATIONS [YMAX # = 163]
Mixed Layer Depth (meters) #OBSERVATIONS: 163
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL JULY 1983
OF OBSERVATIONS [YMAX # = 83]
Mixed Layer Depth (meters) #OBSERVATIONS: 83
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH JULY 1983
OF OBSERVATIONS [YMAX # = 3]
Mixed Layer Depth (meters) #OBSERVATIONS: 3
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE JULY 1983
OF OBSERVATIONS [YMAX # = 4]
Mixed Layer Depth (meters) #OBSERVATIONS: 4
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY JULY 1983
OF OBSERVATIONS [YMAX # = 31]
Mixed Layer Depth (meters) #OBSERVATIONS: 31
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE JULY 1983
OF OBSERVATIONS [YMAX # = 3]
Mixed Layer Depth (meters) #OBSERVATIONS: 3
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE JULY 1983
OF OBSERVATIONS [YMAX # = 38]
Mixed Layer Depth (meters) #OBSERVATIONS: 38
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT JULY 1983
OF OBSERVATIONS [YMAX # = 4027]
Mixed Layer Depth (meters) #OBSERVATIONS: 4027
[MEAN(x)=0.00000,VAR(x)=0.00000]

Figure 72

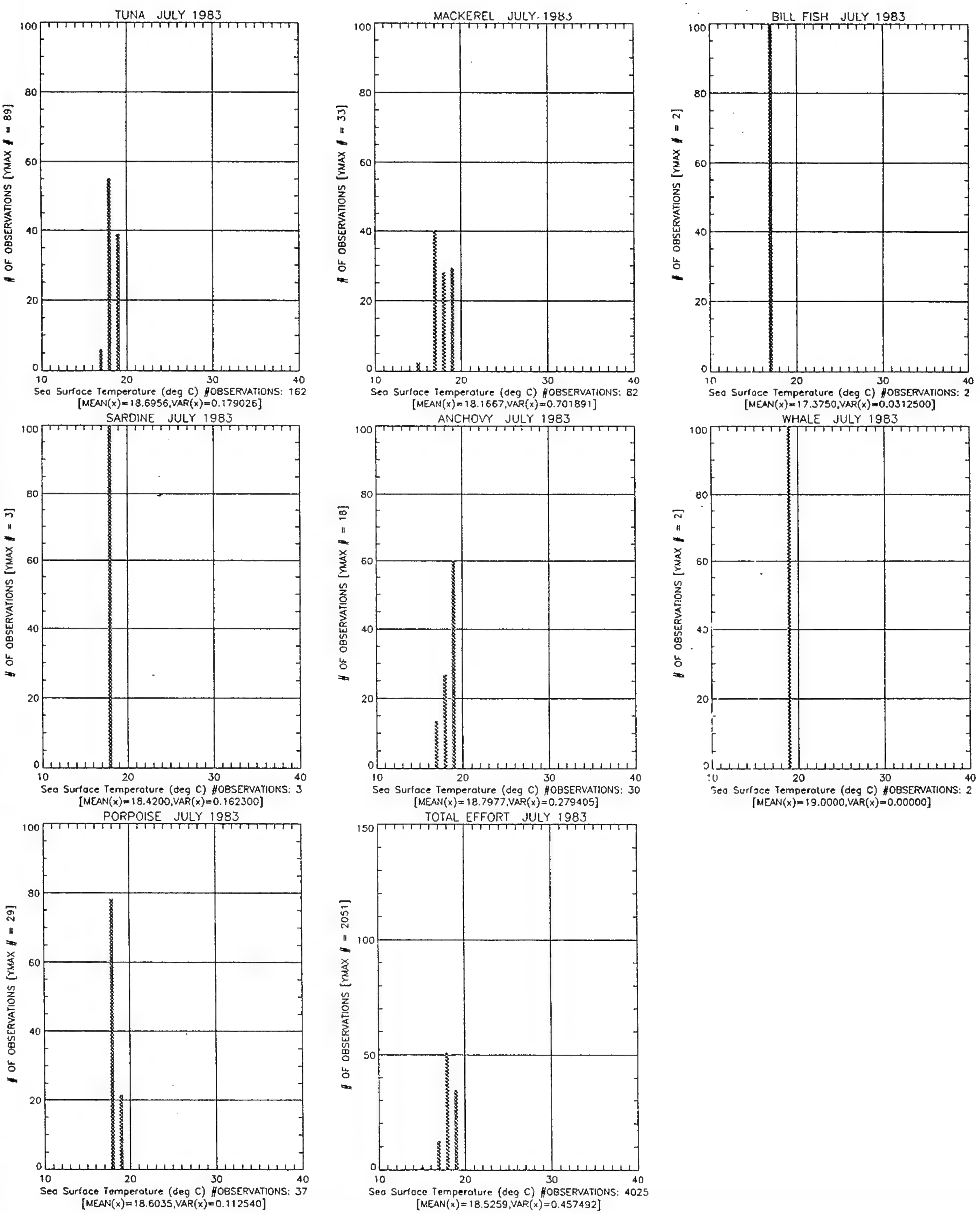

TUNA JULY 1983
OF OBSERVATIONS [YMAX # = 89]
Sea Surface Temperature (deg C) #OBSERVATIONS: 162
[MEAN(x)=18.6956,VAR(x)=0.179026]
MACKEREL JULY 1983
OF OBSERVATIONS [YMAX # = 33]
Sea Surface Temperature (deg C) #OBSERVATIONS: 82
[MEAN(x)=18.1667,VAR(x)=0.701891]
BILL FISH JULY 1983
OF OBSERVATIONS [YMAX # = 2]
Sea Surface Temperature (deg C) #OBSERVATIONS: 2
[MEAN(x)=17.3750,VAR(x)=0.0312500]
SARDINE JULY 1983
OF OBSERVATIONS [YMAX # = 3]
Sea Surface Temperature (deg C) #OBSERVATIONS: 3
[MEAN(x)=18.4200,VAR(x)=0.162300]
ANCHOVY JULY 1983
OF OBSERVATIONS [YMAX # = 18]
Sea Surface Temperature (deg C) #OBSERVATIONS: 30
[MEAN(x)=18.7977,VAR(x)=0.279405]
WHALE JULY 1983
OF OBSERVATIONS [YMAX # = 2]
Sea Surface Temperature (deg C) #OBSERVATIONS: 2
[MEAN(x)=19.0000,VAR(x)=0.00000]
PORPOISE JULY 1983
OF OBSERVATIONS [YMAX # = 29]
Sea Surface Temperature (deg C) #OBSERVATIONS: 37
[MEAN(x)=18.6035,VAR(x)=0.112540]
TOTAL EFFORT JULY 1983
OF OBSERVATIONS [YMAX # = 2051]
Sea Surface Temperature (deg C) #OBSERVATIONS: 4025
[MEAN(x)=18.5259,VAR(x)=0.457492]

Figure 73

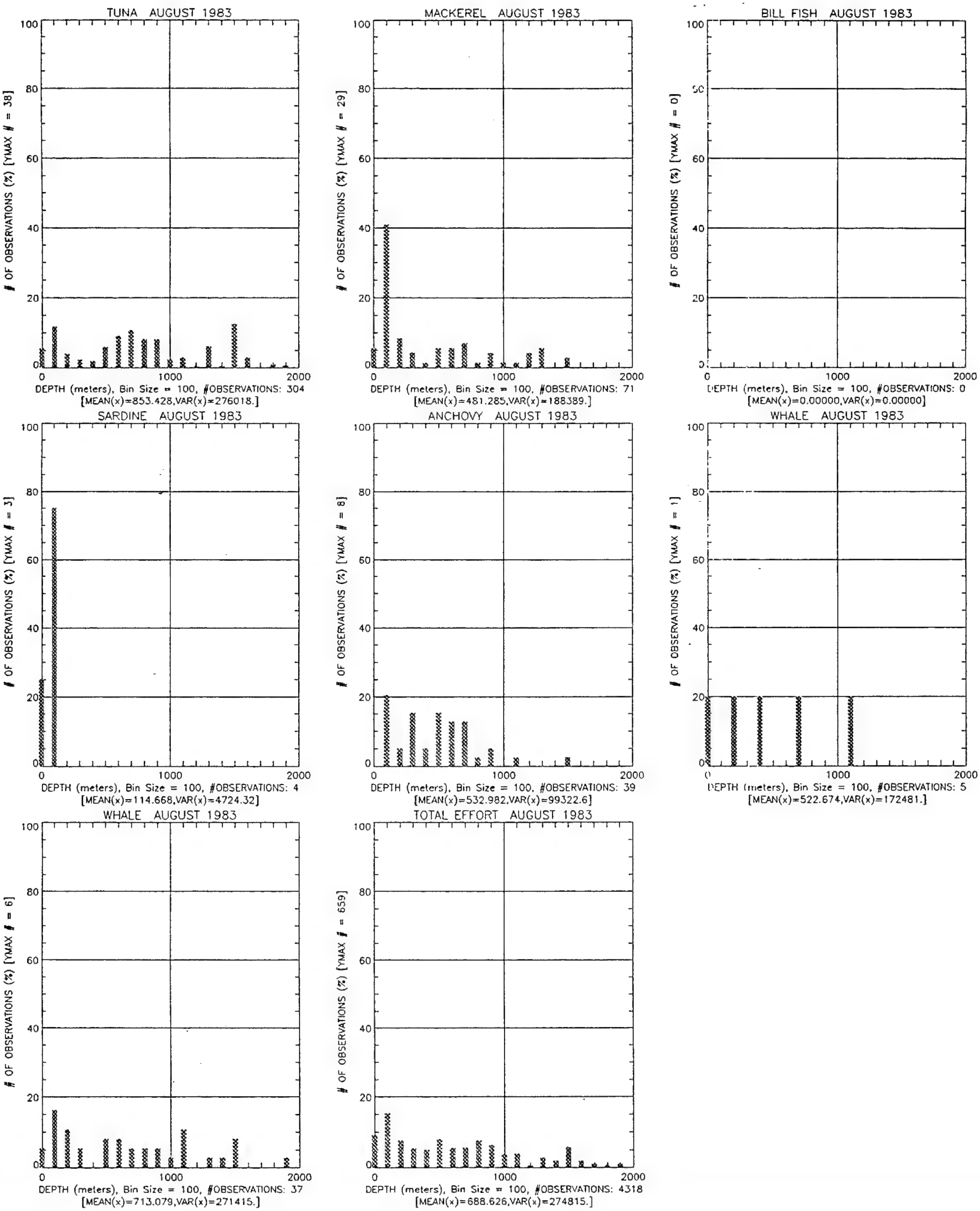

TUNA AUGUST 1983
OF OBSERVATIONS (%) [YMAX # = 38]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 304
[MEAN(x)=853.428,VAR(x)=276018.]
MACKEREL AUGUST 1983
OF OBSERVATIONS (%) [YMAX # = 29]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 71
[MEAN(x)=481.285,VAR(x)=188389.]
BILL FISH AUGUST 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE AUGUST 1983
OF OBSERVATIONS (%) [YMAX # = 3]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 4
[MEAN(x)=114.668,VAR(x)=4724.32]
ANCHOVY AUGUST 1983
OF OBSERVATIONS (%) [YMAX # = 8]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 39
[MEAN(x)=532.982,VAR(x)=99322.6]
WHALE AUGUST 1983
OF OBSERVATIONS (%) [YMAX # = 1]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 5
[MEAN(x)=522.674,VAR(x)=172481.]
WHALE AUGUST 1983
OF OBSERVATIONS (%) [YMAX # = 6]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 37
[MEAN(x)=713.079,VAR(x)=271415.]
TOTAL EFFORT AUGUST 1983
OF OBSERVATIONS (%) [YMAX # = 659]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 4318
[MEAN(x)=688.626,VAR(x)=274815.]

Figure 74

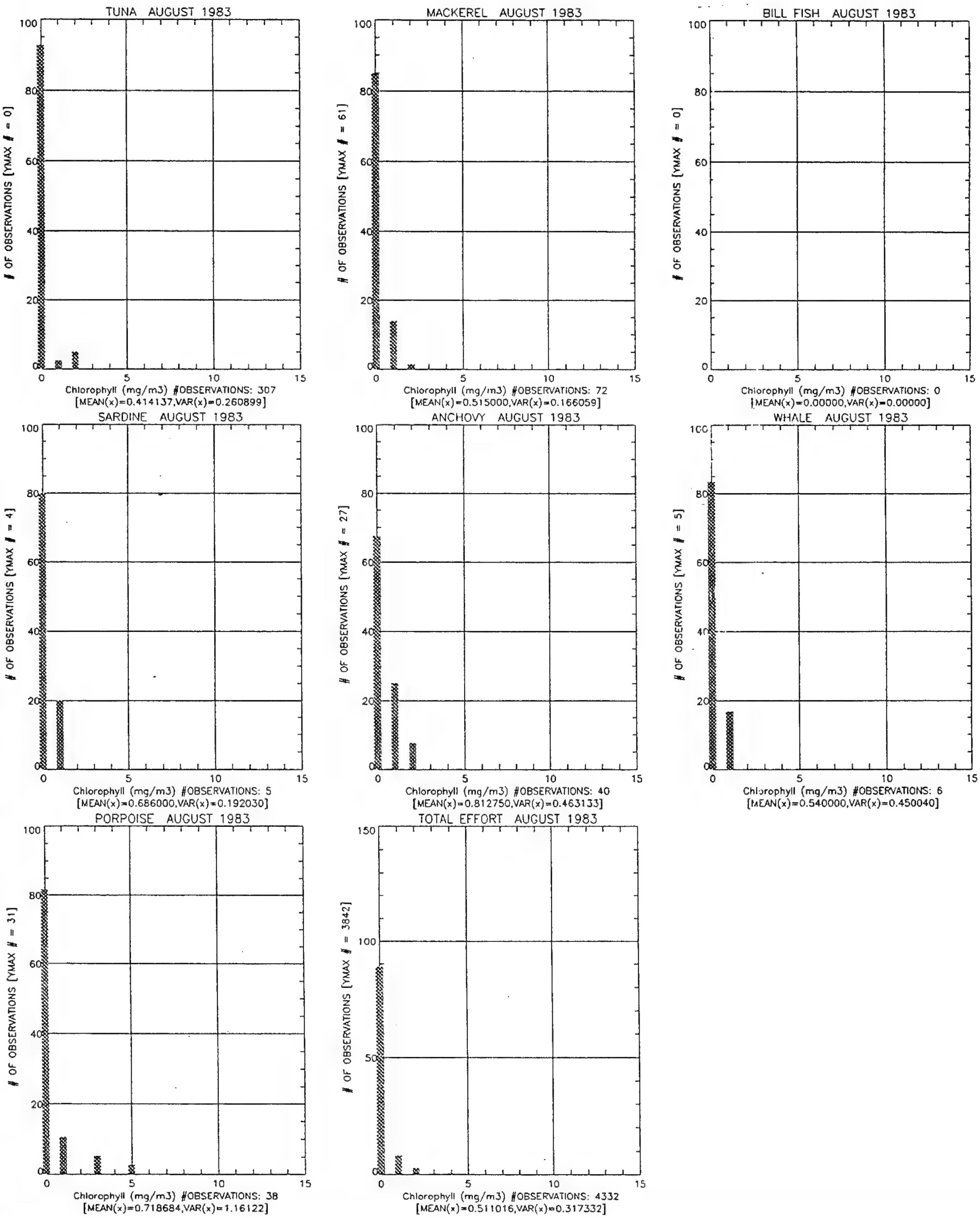

TUNA AUGUST 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 307
[MEAN(x)=0.414137,VAR(x)=0.260899]
MACKEREL AUGUST 1983
OF OBSERVATIONS [YMAX # = 61]
Chlorophyll (mg/m3) #OBSERVATIONS: 72
[MEAN(x)=0.515000,VAR(x)=0.166059]
BILL FISH AUGUST 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE AUGUST 1983
OF OBSERVATIONS [YMAX # = 4]
Chlorophyll (mg/m3) #OBSERVATIONS: 5
[MEAN(x)=0.686000,VAR(x)=0.192030]
ANCHOVY AUGUST 1983
OF OBSERVATIONS [YMAX # = 27]
Chlorophyll (mg/m3) #OBSERVATIONS: 40
[MEAN(x)=0.812750,VAR(x)=0.463133]
WHALE AUGUST 1983
OF OBSERVATIONS [YMAX # = 5]
Chlorophyll (mg/m3) #OBSERVATIONS: 6
[MEAN(x)=0.540000,VAR(x)=0.450040]
PORPOISE AUGUST 1983
OF OBSERVATIONS [YMAX # = 31]
Chlorophyll (mg/m3) #OBSERVATIONS: 38
[MEAN(x)=0.718684,VAR(x)=1.16122]
TOTAL EFFORT AUGUST 1983
OF OBSERVATIONS [YMAX # = 3842]
Chlorophyll (mg/m3) #OBSERVATIONS: 4332
[MEAN(x)=0.511016,VAR(x)=0.317332]

Figure 75

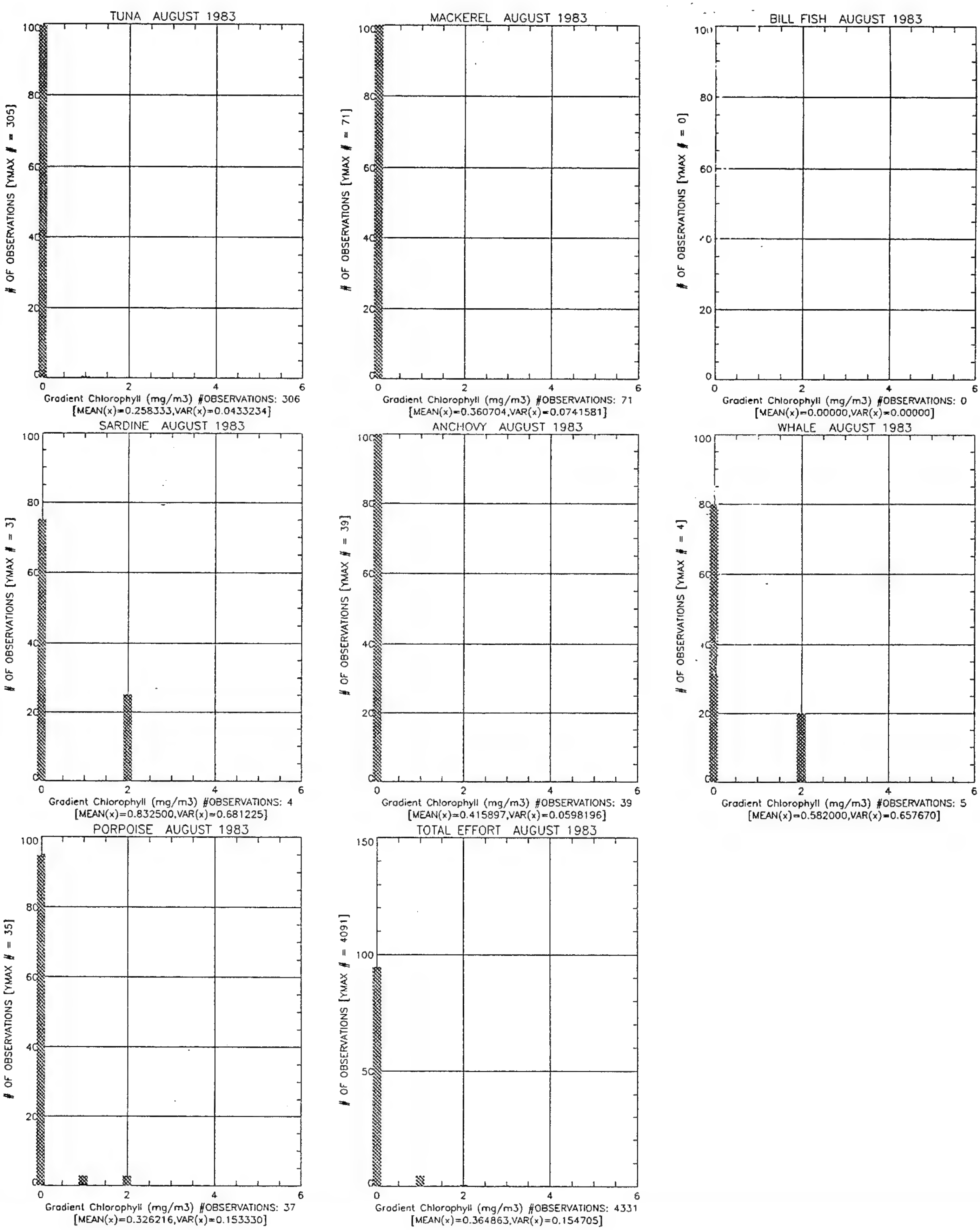
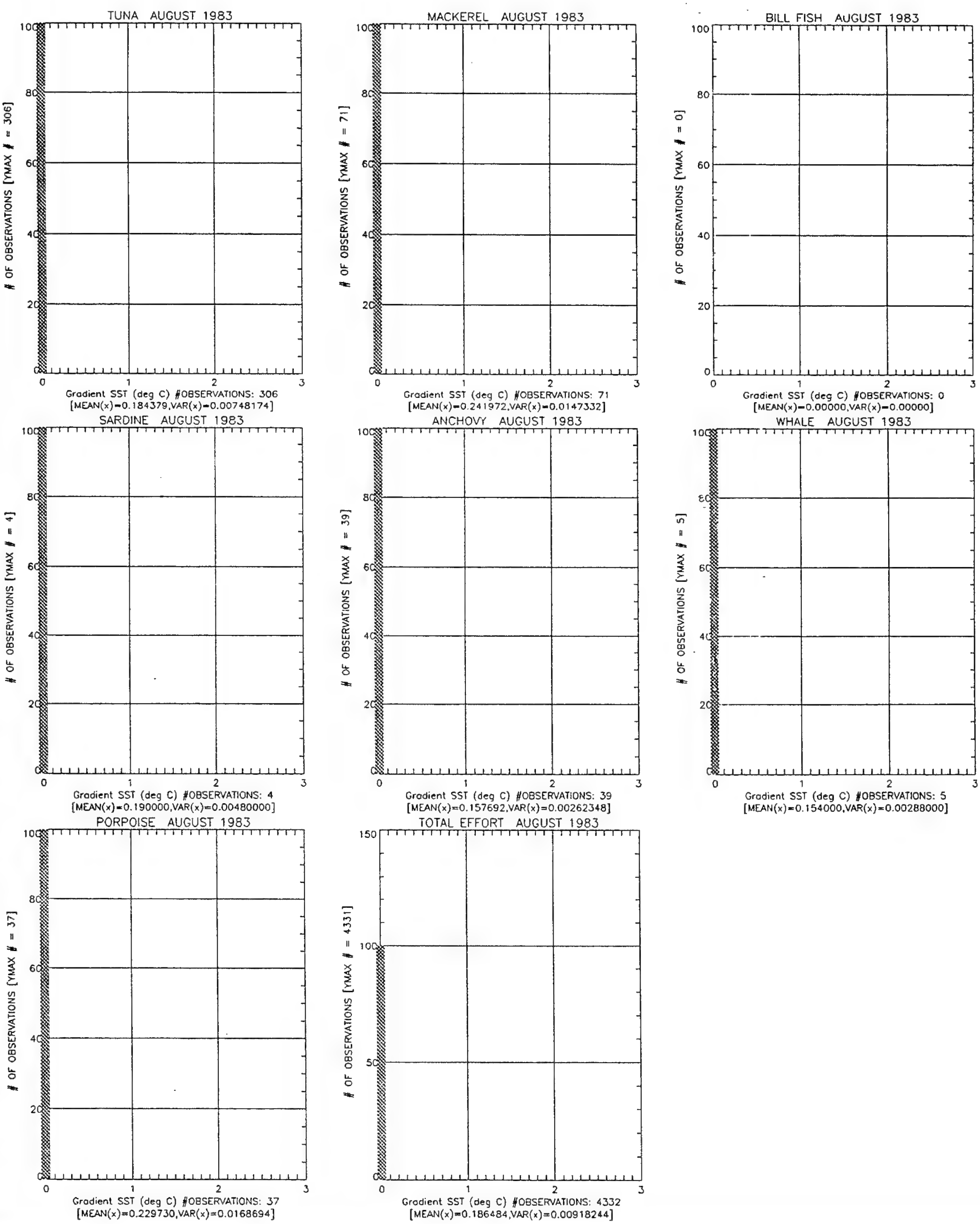
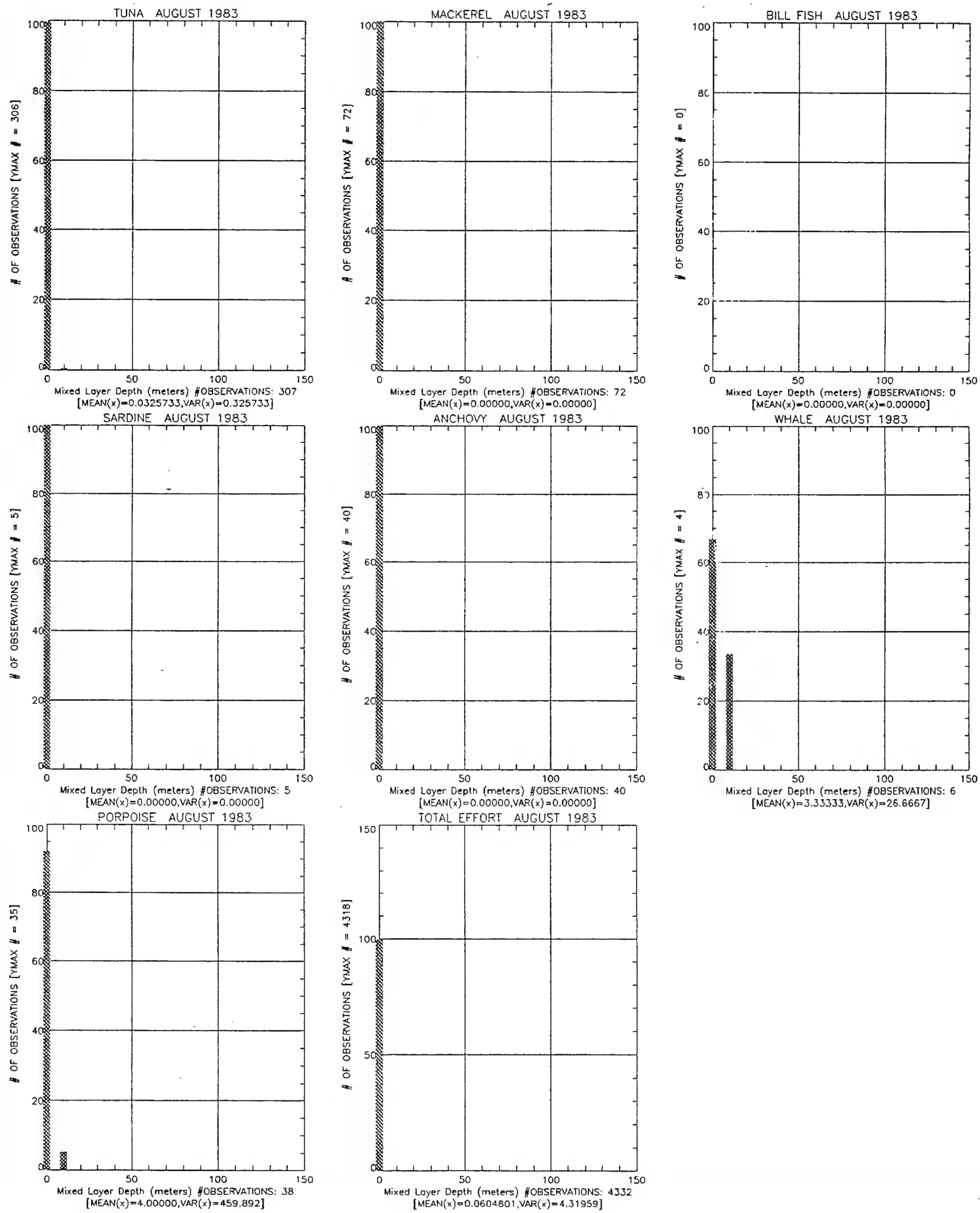

TUNA AUGUST 1983
OF OBSERVATIONS [YMAX # = 305]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 306
[MEAN(x)=0.258333,VAR(x)=0.0433234]
MACKEREL AUGUST 1983
OF OBSERVATIONS [YMAX # = 71]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 71
[MEAN(x)=0.360704,VAR(x)=0.0741581]
BILL FISH AUGUST 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE AUGUST 1983
OF OBSERVATIONS [YMAX # = 3]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 4
[MEAN(x)=0.832500,VAR(x)=0.681225]
ANCHOVY AUGUST 1983
OF OBSERVATIONS [YMAX # = 39]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 39
[MEAN(x)=0.415897,VAR(x)=0.0598196]
WHALE AUGUST 1983
OF OBSERVATIONS [YMAX # = 4]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 5
[MEAN(x)=0.582000,VAR(x)=0.657670]
PORPOISE AUGUST 1983
OF OBSERVATIONS [YMAX # = 35]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 37
[MEAN(x)=0.326216,VAR(x)=0.153330]
TOTAL EFFORT AUGUST 1983
OF OBSERVATIONS [YMAX # = 4091]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 4331
[MEAN(x)=0.364863,VAR(x)=0.154705]

Figure 76



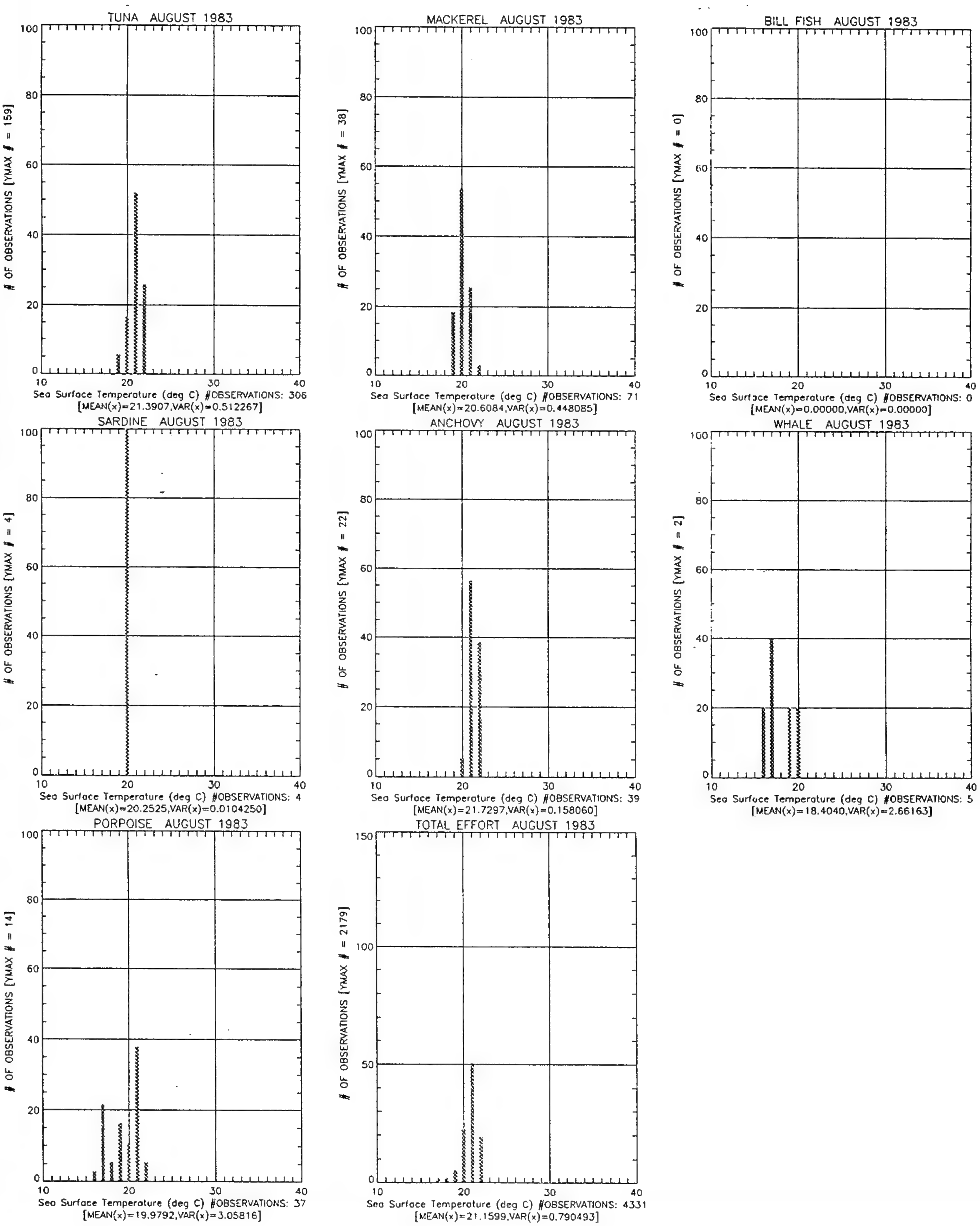
TUNA AUGUST 1983
OF OBSERVATIONS [YMAX # = 306]
Gradient SST (deg C) #OBSERVATIONS: 306
[MEAN(x)=0.184379,VAR(x)=0.00748174]
MACKEREL AUGUST 1983
OF OBSERVATIONS [YMAX # = 71]
Gradient SST (deg C) #OBSERVATIONS: 71
[MEAN(x)=0.241972,VAR(x)=0.0147332]
BILL FISH AUGUST 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE AUGUST 1983
OF OBSERVATIONS [YMAX # = 4]
Gradient SST (deg C) #OBSERVATIONS: 4
[MEAN(x)=0.190000,VAR(x)=0.00480000]
ANCHOVY AUGUST 1983
OF OBSERVATIONS [YMAX # = 39]
Gradient SST (deg C) #OBSERVATIONS: 39
[MEAN(x)=0.157692,VAR(x)=0.00262348]
WHALE AUGUST 1983
OF OBSERVATIONS [YMAX # = 5]
Gradient SST (deg C) #OBSERVATIONS: 5
[MEAN(x)=0.154000,VAR(x)=0.00288000]
PORPOISE AUGUST 1983
OF OBSERVATIONS [YMAX # = 37]
Gradient SST (deg C) #OBSERVATIONS: 37
[MEAN(x)=0.229730,VAR(x)=0.0168694]
TOTAL EFFORT AUGUST 1983
OF OBSERVATIONS [YMAX # = 4331]
Gradient SST (deg C) #OBSERVATIONS: 4332
[MEAN(x)=0.186484,VAR(x)=0.00918244]

Figure 77



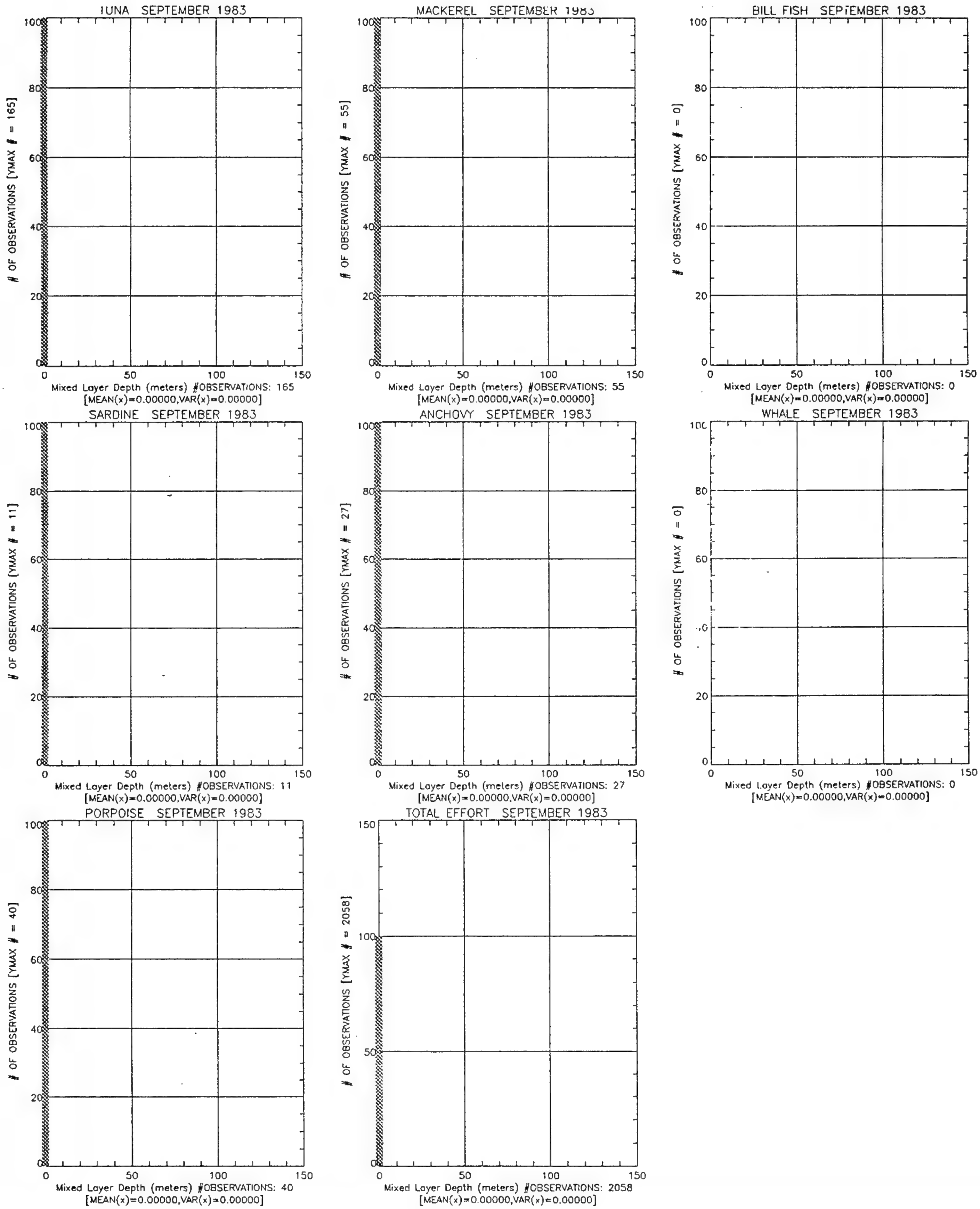
TUNA AUGUST 1983
OF OBSERVATIONS [YMAX # = 306]
Mixed Layer Depth (meters) #OBSERVATIONS: 307
[MEAN(x)=0.0325733,VAR(x)=0.325733]
MACKEREL AUGUST 1983
OF OBSERVATIONS [YMAX # = 72]
Mixed Layer Depth (meters) #OBSERVATIONS: 72
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH AUGUST 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE AUGUST 1983
OF OBSERVATIONS [YMAX # = 5]
Mixed Layer Depth (meters) #OBSERVATIONS: 5
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY AUGUST 1983
OF OBSERVATIONS [YMAX # = 40]
Mixed Layer Depth (meters) #OBSERVATIONS: 40
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE AUGUST 1983
OF OBSERVATIONS [YMAX # = 4]
Mixed Layer Depth (meters) #OBSERVATIONS: 6
[MEAN(x)=3.33333,VAR(x)=26.6667]
PORPOISE AUGUST 1983
OF OBSERVATIONS [YMAX # = 35]
Mixed Layer Depth (meters) #OBSERVATIONS: 38
[MEAN(x)=4.00000,VAR(x)=459.892]
TOTAL EFFORT AUGUST 1983
OF OBSERVATIONS [YMAX # = 4318]
Mixed Layer Depth (meters) #OBSERVATIONS: 4332
[MEAN(x)=0.0604801,VAR(x)=4.31959]

Figure 78



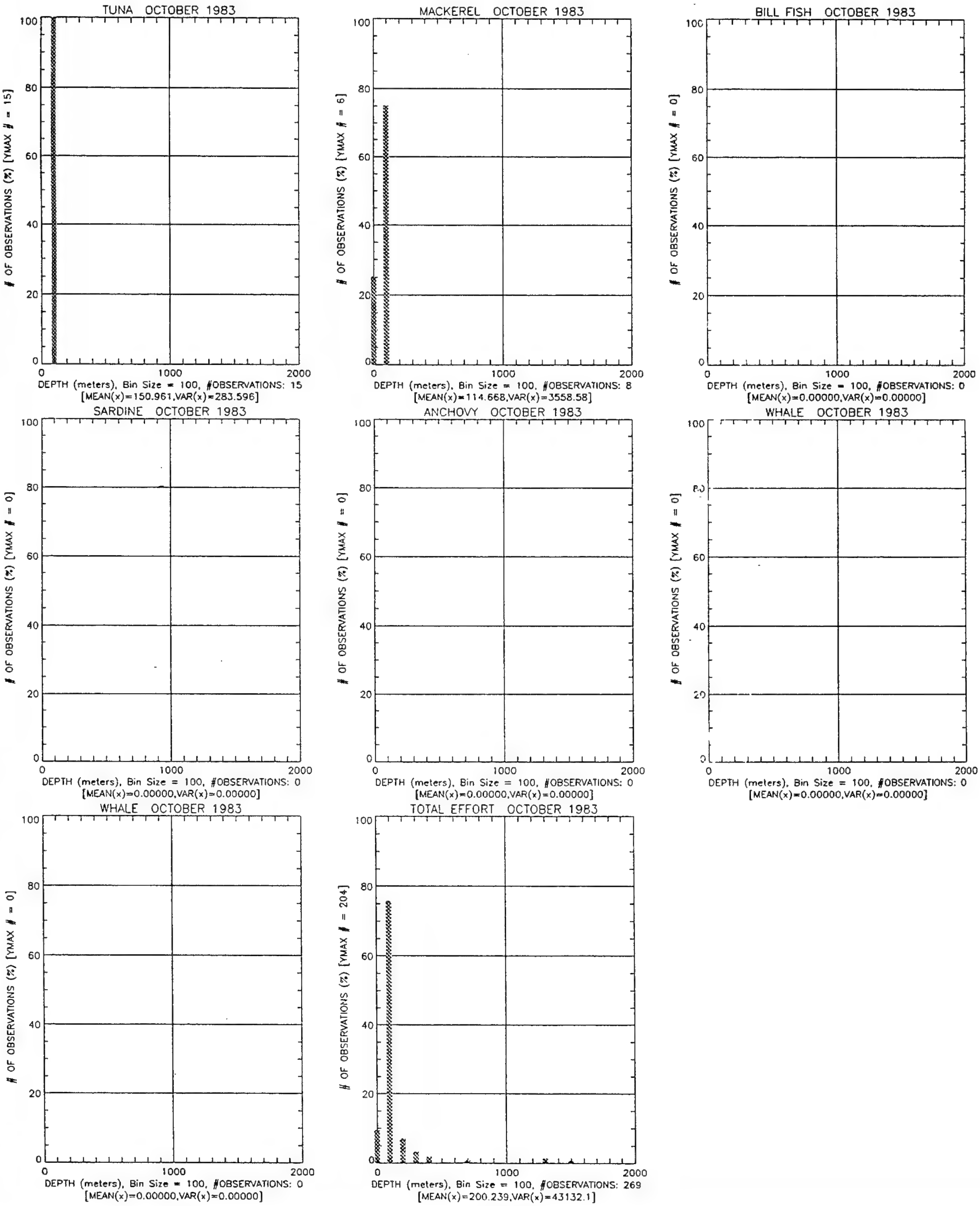
TUNA AUGUST 1983
OF OBSERVATIONS [YMAX # = 159]
Sea Surface Temperature (deg C) #OBSERVATIONS: 306
[MEAN(x)=21.3907,VAR(x)=0.512267]
MACKEREL AUGUST 1983
OF OBSERVATIONS [YMAX # = 38]
Sea Surface Temperature (deg C) #OBSERVATIONS: 71
[MEAN(x)=20.6084,VAR(x)=0.448085]
BILL FISH AUGUST 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE AUGUST 1983
OF OBSERVATIONS [YMAX # = 4]
Sea Surface Temperature (deg C) #OBSERVATIONS: 4
[MEAN(x)=20.2525,VAR(x)=0.0104250]
ANCHOVY AUGUST 1983
OF OBSERVATIONS [YMAX # = 22]
Sea Surface Temperature (deg C) #OBSERVATIONS: 39
[MEAN(x)=21.7297,VAR(x)=0.158060]
WHALE AUGUST 1983
OF OBSERVATIONS [YMAX # = 2]
Sea Surface Temperature (deg C) #OBSERVATIONS: 5
[MEAN(x)=18.4040,VAR(x)=2.66163]
PORPOISE AUGUST 1983
OF OBSERVATIONS [YMAX # = 14]
Sea Surface Temperature (deg C) #OBSERVATIONS: 37
[MEAN(x)=19.9792,VAR(x)=3.05816]
TOTAL EFFORT AUGUST 1983
OF OBSERVATIONS [YMAX # = 2179]
Sea Surface Temperature (deg C) #OBSERVATIONS: 4331
[MEAN(x)=21.1599,VAR(x)=0.790493]

Figure 79



TUNA SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 165]
Mixed Layer Depth (meters) #OBSERVATIONS: 165
[MEAN(x)=0.00000,VAR(x)=0.00000]
MACKEREL SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 55]
Mixed Layer Depth (meters) #OBSERVATIONS: 55
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 11]
Mixed Layer Depth (meters) #OBSERVATIONS: 11
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 27]
Mixed Layer Depth (meters) #OBSERVATIONS: 27
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 40]
Mixed Layer Depth (meters) #OBSERVATIONS: 40
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT SEPTEMBER 1983
OF OBSERVATIONS [YMAX # = 2058]
Mixed Layer Depth (meters) #OBSERVATIONS: 2058
[MEAN(x)=0.00000,VAR(x)=0.00000]

Figure 80



TUNA OCTOBER 1983
OF OBSERVATIONS (%) [YMAX # = 15]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 15
[MEAN(x)=150.961,VAR(x)=283.596]
MACKEREL OCTOBER 1983
OF OBSERVATIONS (%) [YMAX # = 6]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 8
[MEAN(x)=114.668,VAR(x)=3558.58]
BILL FISH OCTOBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE OCTOBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY OCTOBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE OCTOBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE OCTOBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT OCTOBER 1983
OF OBSERVATIONS (%) [YMAX # = 204]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 269
[MEAN(x)=200.239,VAR(x)=43132.1]

Figure 81

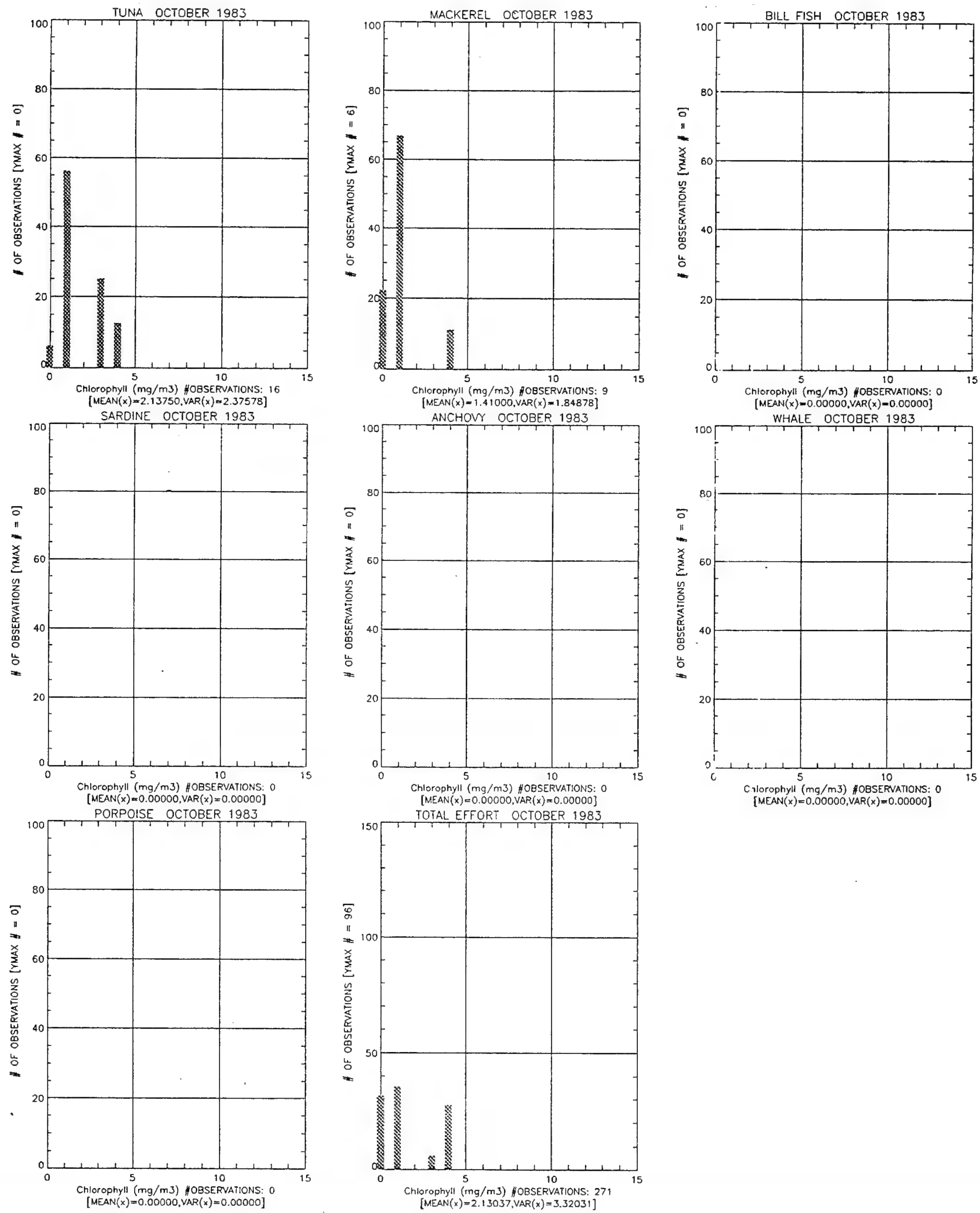
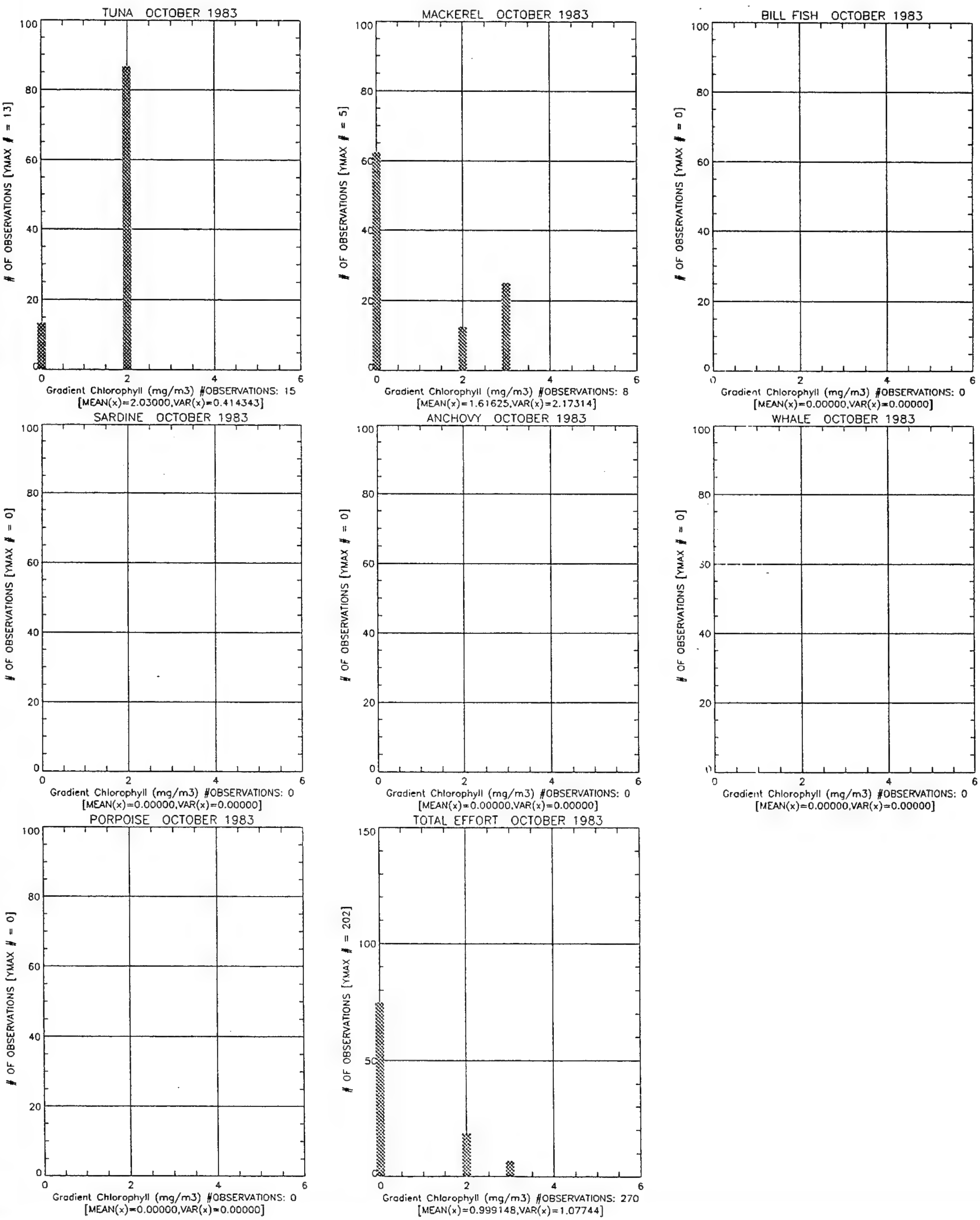
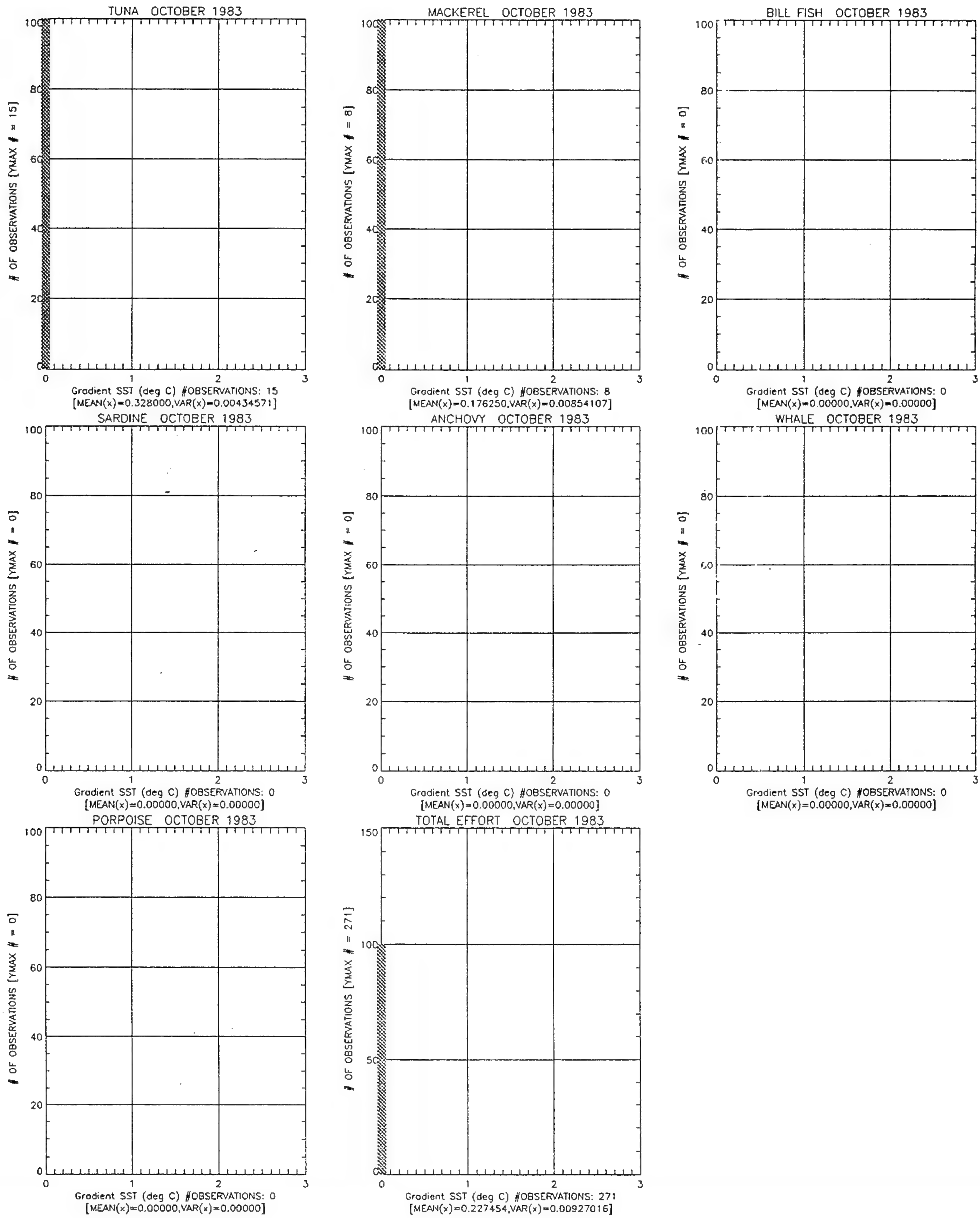

TUNA OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 16
[MEAN(x)=2.13750,VAR(x)=2.37578]
MACKEREL OCTOBER 1983
OF OBSERVATIONS [YMAX # = 6]
Chlorophyll (mg/m3) #OBSERVATIONS: 9
[MEAN(x)=1.41000,VAR(x)=1.84878]
BILL FISH OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT OCTOBER 1983
OF OBSERVATIONS [YMAX # = 96]
Chlorophyll (mg/m3) #OBSERVATIONS: 271
[MEAN(x)=2.13037,VAR(x)=3.32031]

Figure 82



TUNA OCTOBER 1983
OF OBSERVATIONS [YMAX # = 13]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 15
[MEAN(x)=2.03000,VAR(x)=0.414343]
MACKEREL OCTOBER 1983
OF OBSERVATIONS [YMAX # = 5]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 8
[MEAN(x)=1.61625,VAR(x)=2.17314]
BILL FISH OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT OCTOBER 1983
OF OBSERVATIONS [YMAX # = 202]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 270
[MEAN(x)=0.999148,VAR(x)=1.07744]

Figure 83



TUNA OCTOBER 1983
OF OBSERVATIONS [YMAX # = 15]
Gradient SST (deg C) #OBSERVATIONS: 15
[MEAN(x)=0.328000,VAR(x)=0.00434571]
MACKEREL OCTOBER 1983
OF OBSERVATIONS [YMAX # = 8]
Gradient SST (deg C) #OBSERVATIONS: 8
[MEAN(x)=0.176250,VAR(x)=0.00854107]
BILL FISH OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT OCTOBER 1983
OF OBSERVATIONS [YMAX # = 271]
Gradient SST (deg C) #OBSERVATIONS: 271
[MEAN(x)=0.227454,VAR(x)=0.00927016]

Figure 84

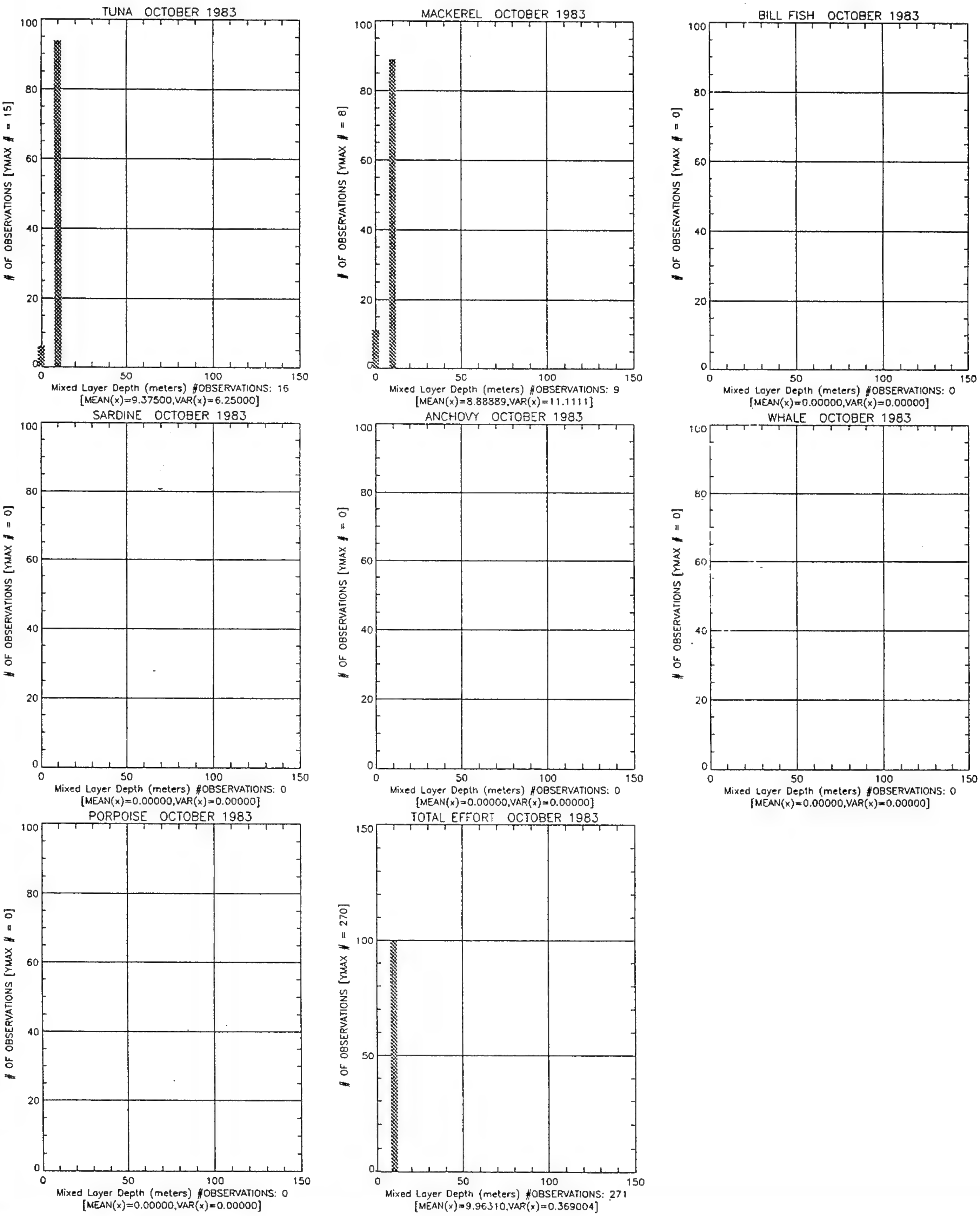

TUNA OCTOBER 1983
OF OBSERVATIONS [YMAX # = 15]
Mixed Layer Depth (meters) #OBSERVATIONS: 16
[MEAN(x)=9.37500,VAR(x)=6.25000]
MACKEREL OCTOBER 1983
OF OBSERVATIONS [YMAX # = 8]
Mixed Layer Depth (meters) #OBSERVATIONS: 9
[MEAN(x)=8.88889,VAR(x)=11.1111]
BILL FISH OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT OCTOBER 1983
OF OBSERVATIONS [YMAX # = 270]
Mixed Layer Depth (meters) #OBSERVATIONS: 271
[MEAN(x)=9.96310,VAR(x)=0.369004]

Figure 85

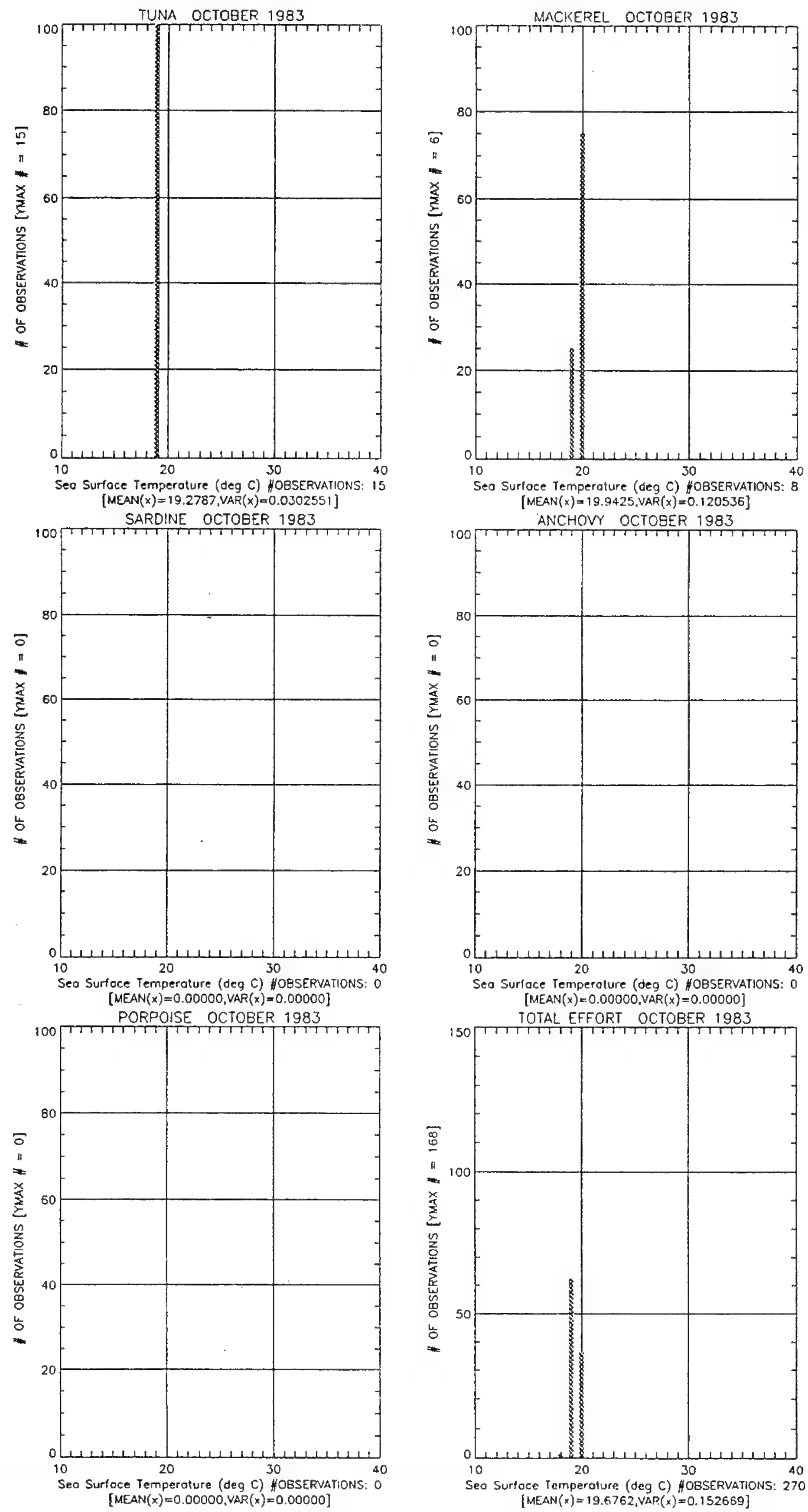
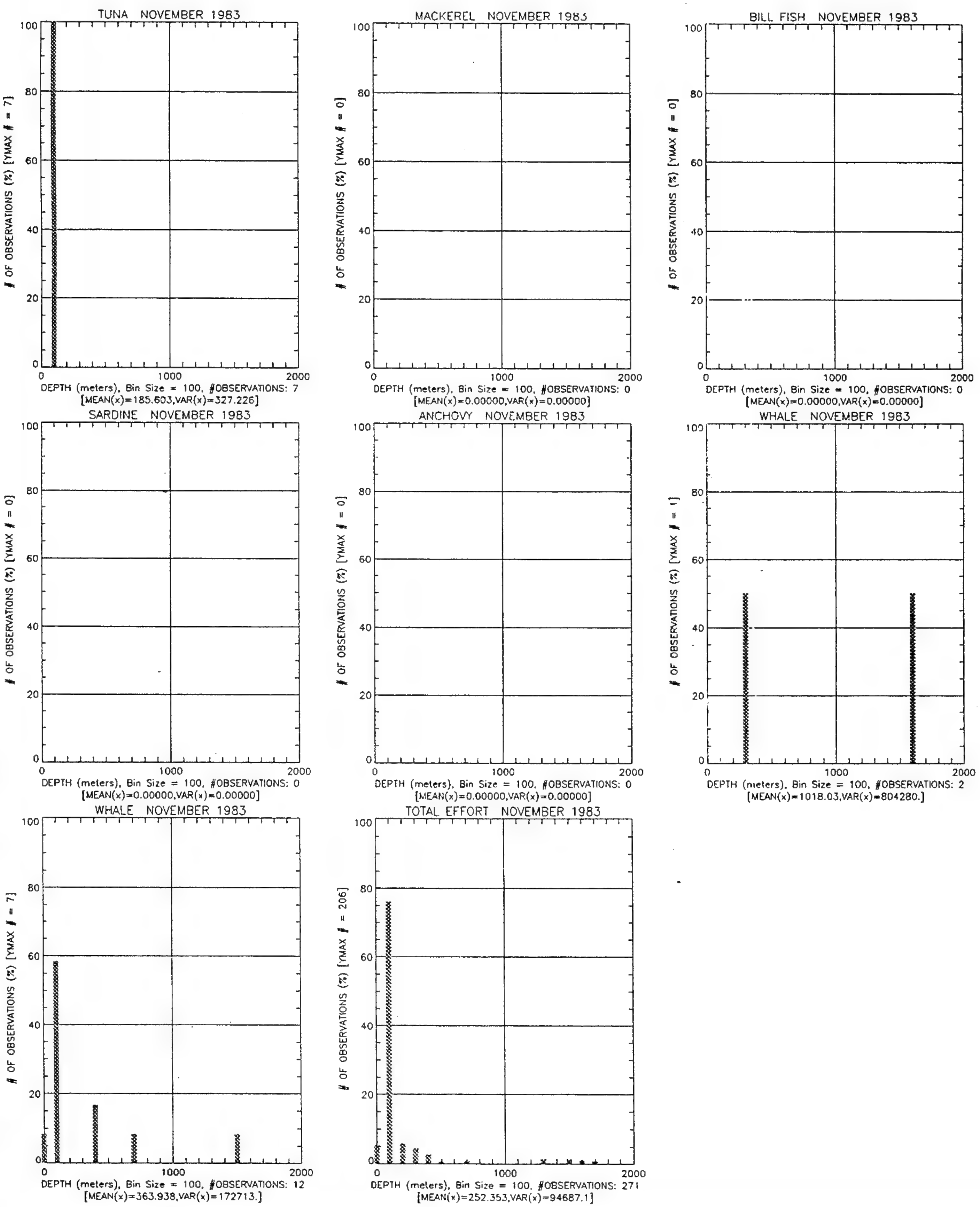

TUNA OCTOBER 1983
OF OBSERVATIONS [YMAX # = 15]
Sea Surface Temperature (deg C) #OBSERVATIONS: 15
[MEAN(x)=19.2787,VAR(x)=0.0302551]
MACKEREL OCTOBER 1983
OF OBSERVATIONS [YMAX # = 6]
Sea Surface Temperature (deg C) #OBSERVATIONS: 8
[MEAN(x)=19.9425,VAR(x)=0.120536]
BILL FISH OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE OCTOBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT OCTOBER 1983
OF OBSERVATIONS [YMAX # = 168]
Sea Surface Temperature (deg C) #OBSERVATIONS: 270
[MEAN(x)=19.6762,VAR(x)=0.152669]

Figure 86



TUNA NOVEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 7]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 7
[MEAN(x)=185.603,VAR(x)=327.226]
MACKEREL NOVEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH NOVEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE NOVEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY NOVEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE NOVEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 1]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 2
[MEAN(x)=1018.03,VAR(x)=804280.]
WHALE NOVEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 7]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 12
[MEAN(x)=363.938,VAR(x)=172713.]
TOTAL EFFORT NOVEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 206]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 271
[MEAN(x)=252.353,VAR(x)=94687.1]

Figure 87

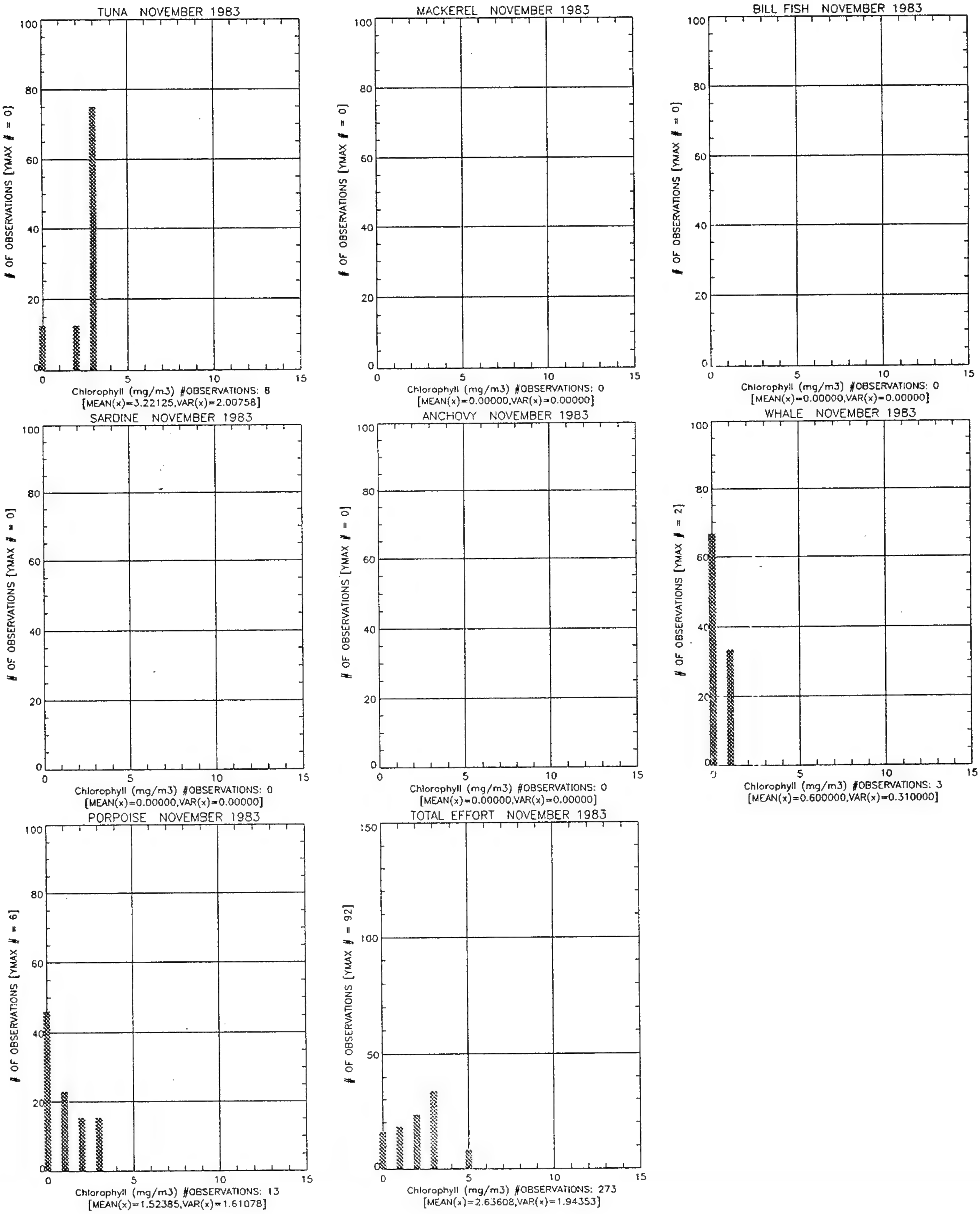

TUNA NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 8
[MEAN(x)=3.22125,VAR(x)=2.00758]
MACKEREL NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 2]
Chlorophyll (mg/m3) #OBSERVATIONS: 3
[MEAN(x)=0.600000,VAR(x)=0.310000]
PORPOISE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 6]
Chlorophyll (mg/m3) #OBSERVATIONS: 13
[MEAN(x)=1.52385,VAR(x)=1.61078]
TOTAL EFFORT NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 92]
Chlorophyll (mg/m3) #OBSERVATIONS: 273
[MEAN(x)=2.63608,VAR(x)=1.94353]

Figure 88

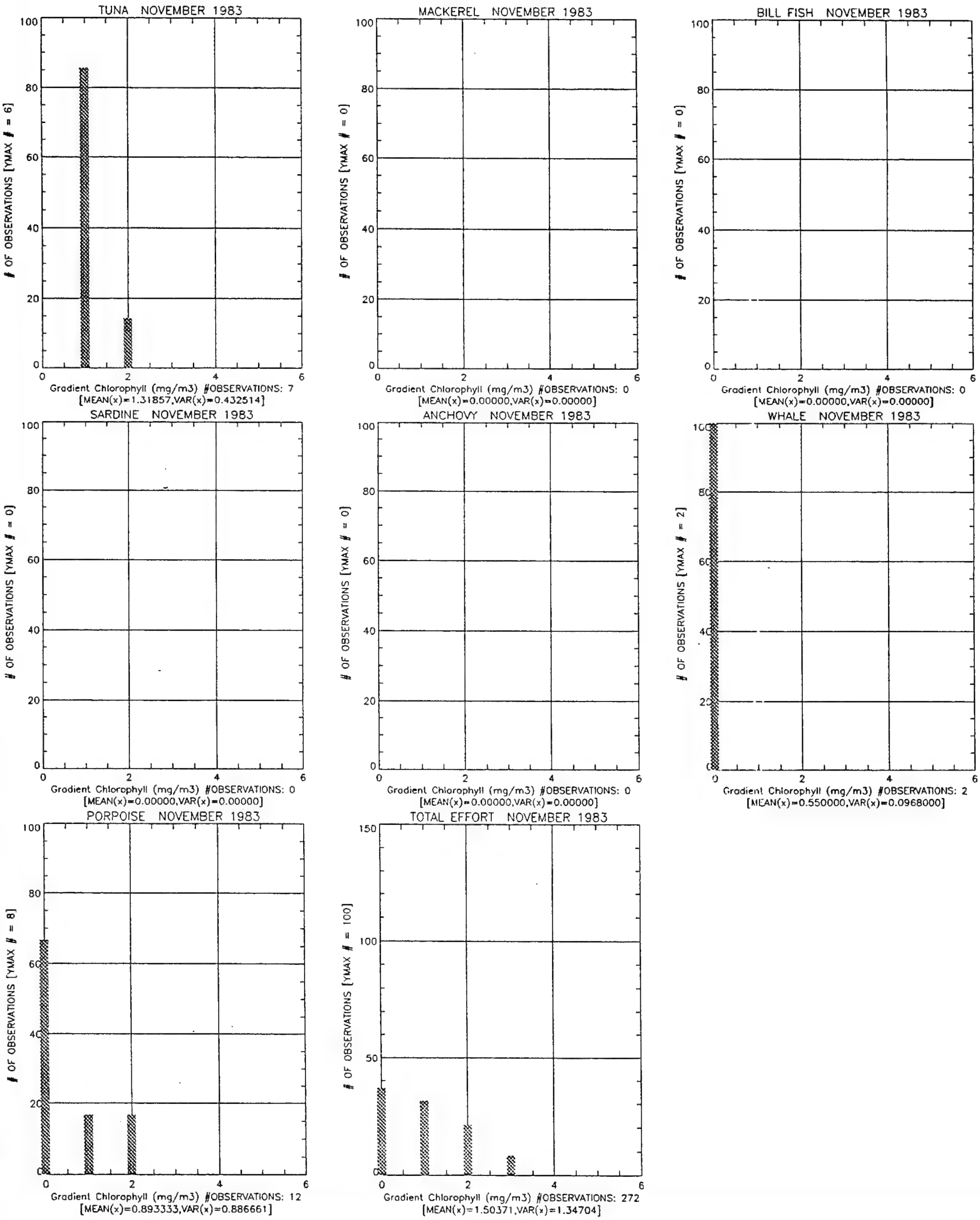

TUNA NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 6]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 7
[MEAN(x)=1.31857,VAR(x)=0.432514]
MACKEREL NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 2
[MEAN(x)=0.550000,VAR(x)=0.0968000]
PORPOISE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 8]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 12
[MEAN(x)=0.893333,VAR(x)=0.886661]
TOTAL EFFORT NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 100]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 272
[MEAN(x)=1.50371,VAR(x)=1.34704]

Figure 89

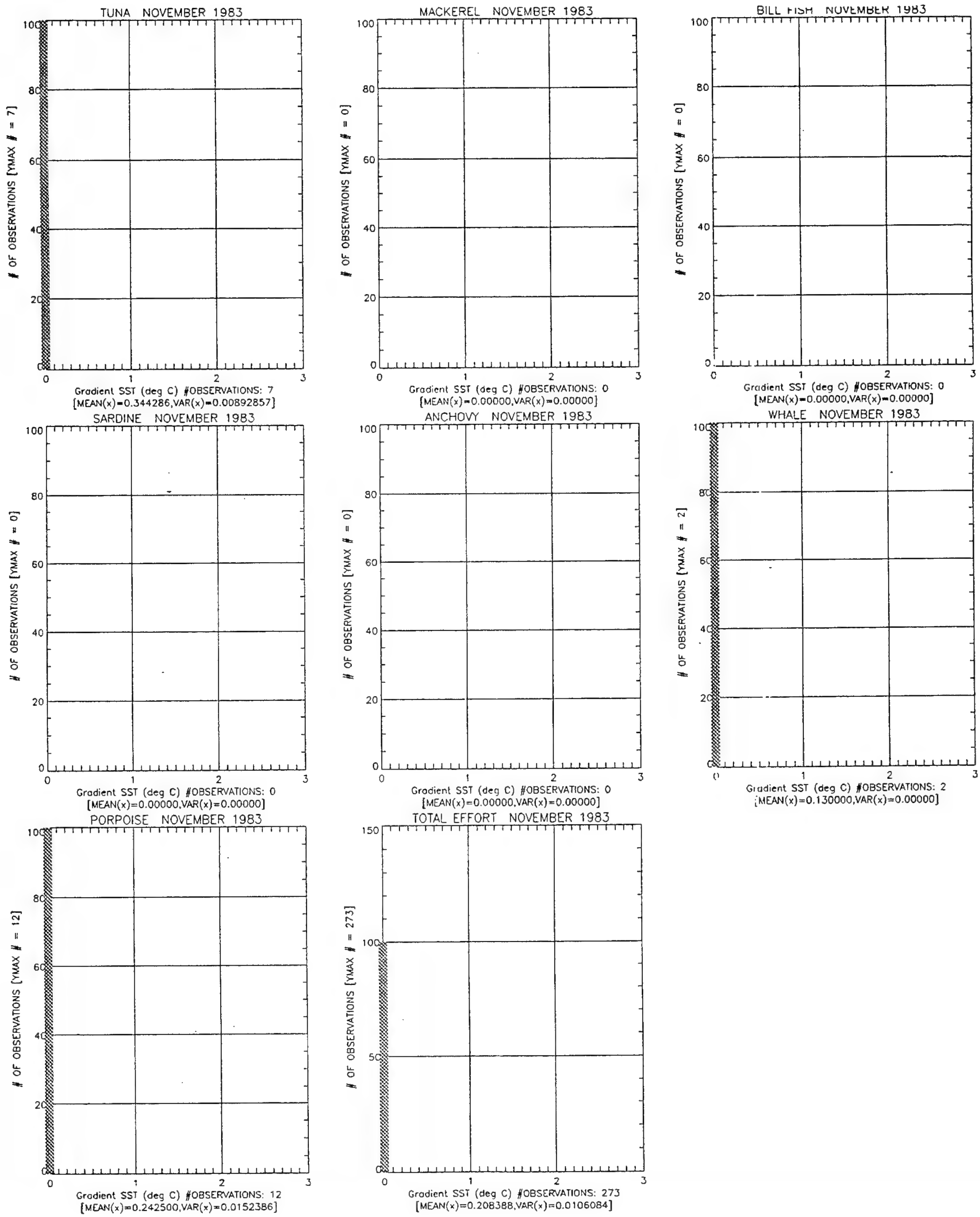

TUNA NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 7]
Gradient SST (deg C) #OBSERVATIONS: 7
[MEAN(x)=0.344286,VAR(x)=0.00892857]
MACKEREL NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient SST (deg C) #OBSERVATIONS: 2
[MEAN(x)=0.130000,VAR(x)=0.00000]
PORPOISE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 12]
Gradient SST (deg C) #OBSERVATIONS: 12
[MEAN(x)=0.242500,VAR(x)=0.0152386]
TOTAL EFFORT NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 273]
Gradient SST (deg C) #OBSERVATIONS: 273
[MEAN(x)=0.208388,VAR(x)=0.0106084]

Figure 90

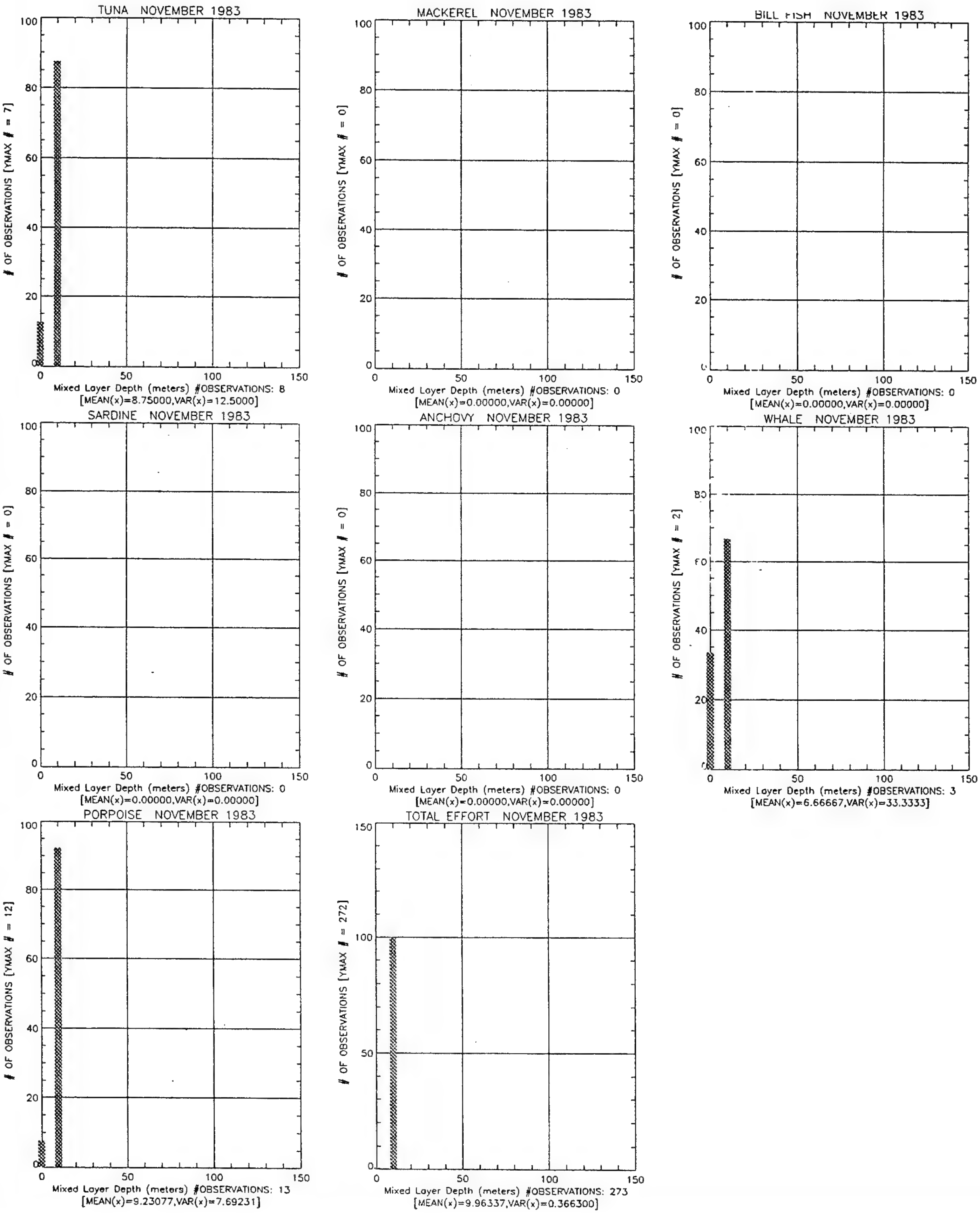
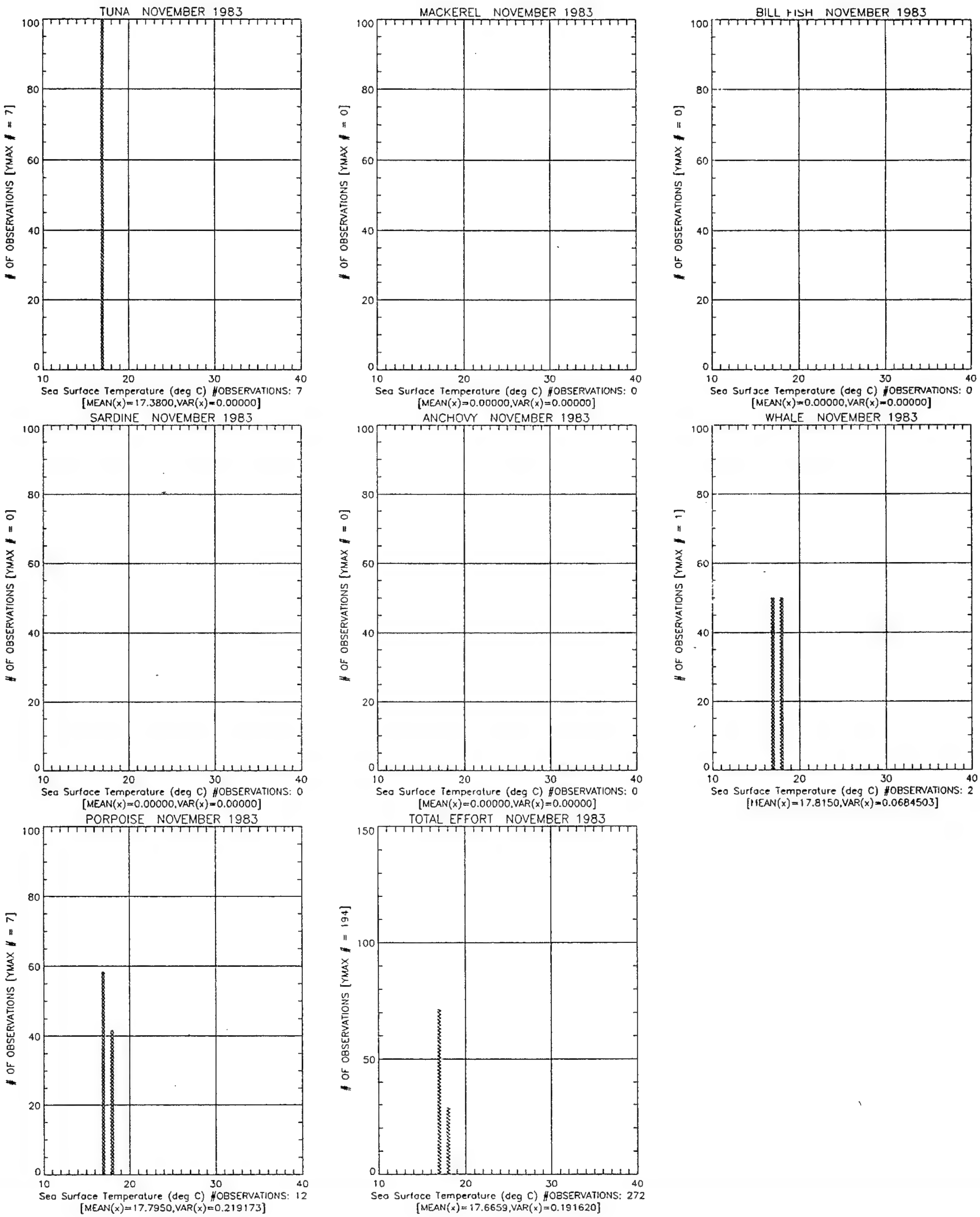
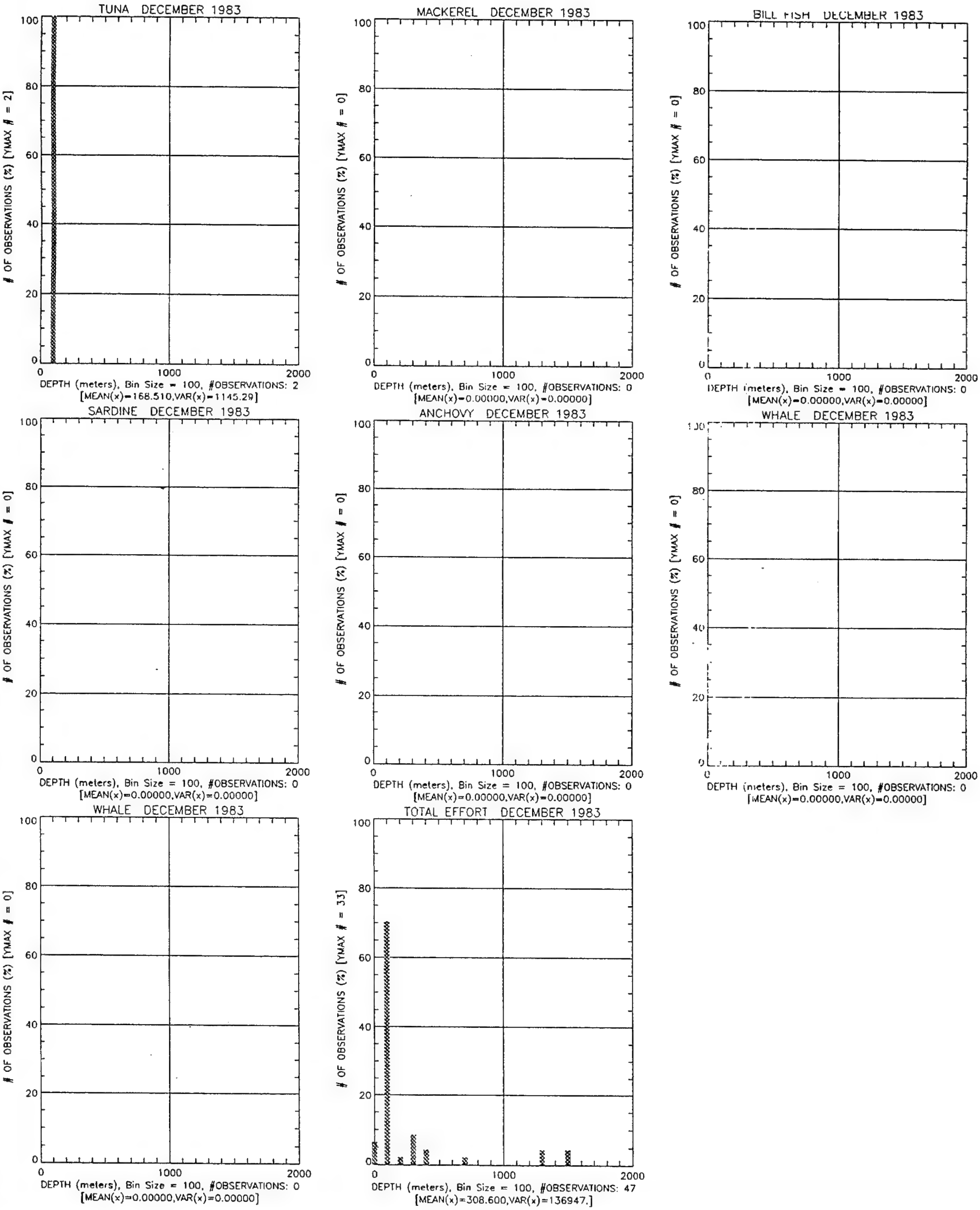

TUNA NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 7]
Mixed Layer Depth (meters) #OBSERVATIONS: 8
[MEAN(x)=8.75000,VAR(x)=12.5000]
MACKEREL NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 2]
Mixed Layer Depth (meters) #OBSERVATIONS: 3
[MEAN(x)=6.66667,VAR(x)=33.3333]
PORPOISE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 12]
Mixed Layer Depth (meters) #OBSERVATIONS: 13
[MEAN(x)=9.23077,VAR(x)=7.69231]
TOTAL EFFORT NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 272]
Mixed Layer Depth (meters) #OBSERVATIONS: 273
[MEAN(x)=9.96337,VAR(x)=0.366300]

Figure 91



TUNA NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 7]
Sea Surface Temperature (deg C) #OBSERVATIONS: 7
[MEAN(x)=17.3800,VAR(x)=0.00000]
MACKEREL NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 1]
Sea Surface Temperature (deg C) #OBSERVATIONS: 2
[MEAN(x)=17.8150,VAR(x)=0.0684503]
PORPOISE NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 7]
Sea Surface Temperature (deg C) #OBSERVATIONS: 12
[MEAN(x)=17.7950,VAR(x)=0.219173]
TOTAL EFFORT NOVEMBER 1983
OF OBSERVATIONS [YMAX # = 194]
Sea Surface Temperature (deg C) #OBSERVATIONS: 272
[MEAN(x)=17.6659,VAR(x)=0.191620]

Figure 92



TUNA DECEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 2]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 2
[MEAN(x)=168.510,VAR(x)=1145.29]
MACKEREL DECEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH DECEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE DECEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY DECEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE DECEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE DECEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 0]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT DECEMBER 1983
OF OBSERVATIONS (%) [YMAX # = 33]
DEPTH (meters), Bin Size = 100, #OBSERVATIONS: 47
[MEAN(x)=308.600,VAR(x)=136947.]

Figure 93

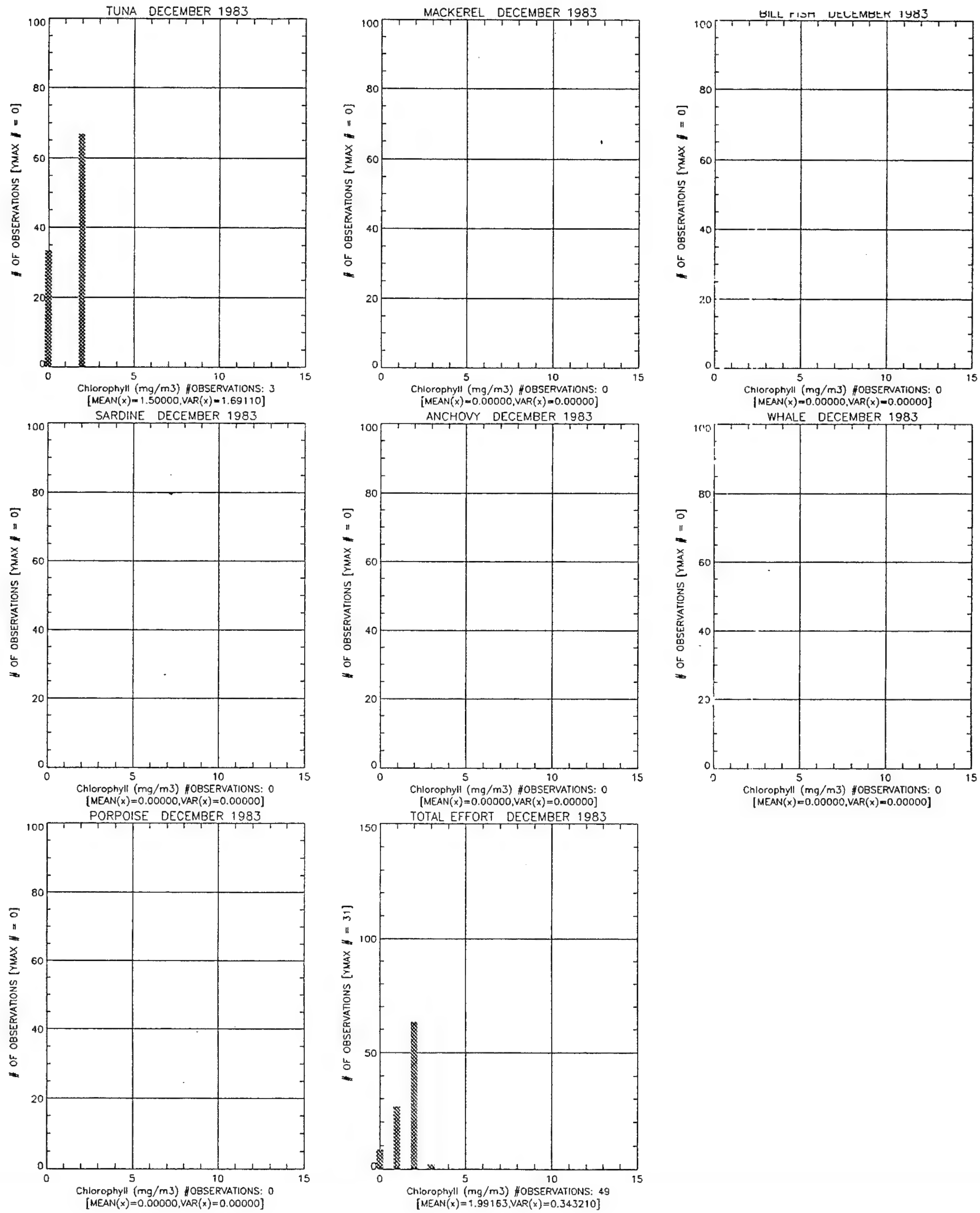
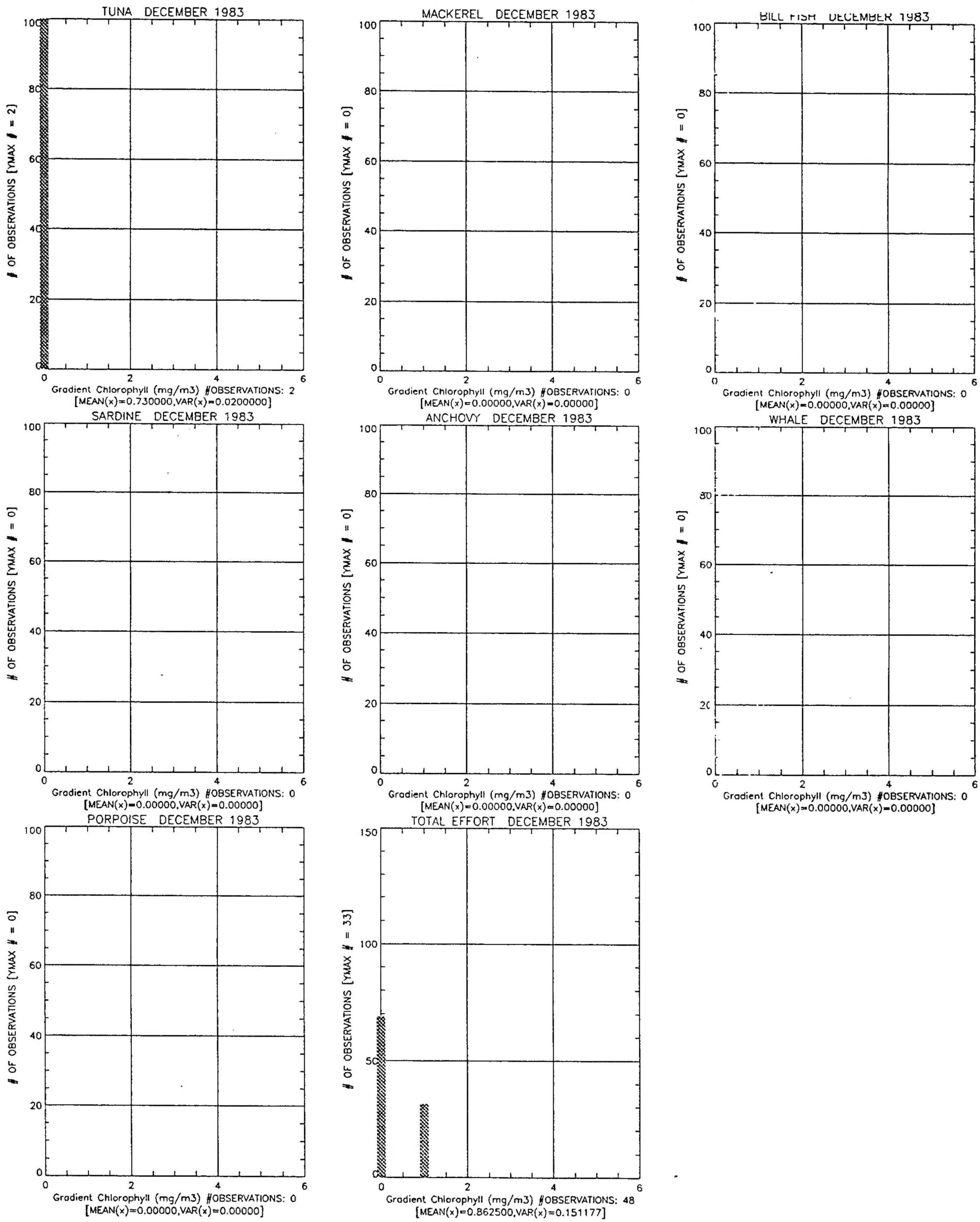

TUNA DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 3
[MEAN(x)=1.50000,VAR(x)=1.69110]
MACKEREL DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT DECEMBER 1983
OF OBSERVATIONS [YMAX # = 31]
Chlorophyll (mg/m3) #OBSERVATIONS: 49
[MEAN(x)=1.99163,VAR(x)=0.343210]

Figure 94



TUNA DECEMBER 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 2
[MEAN(x)=0.730000,VAR(x)=0.0200000]
MACKEREL DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT DECEMBER 1983
OF OBSERVATIONS [YMAX # = 33]
Gradient Chlorophyll (mg/m3) #OBSERVATIONS: 48
[MEAN(x)=0.862500,VAR(x)=0.151177]

Figure 95

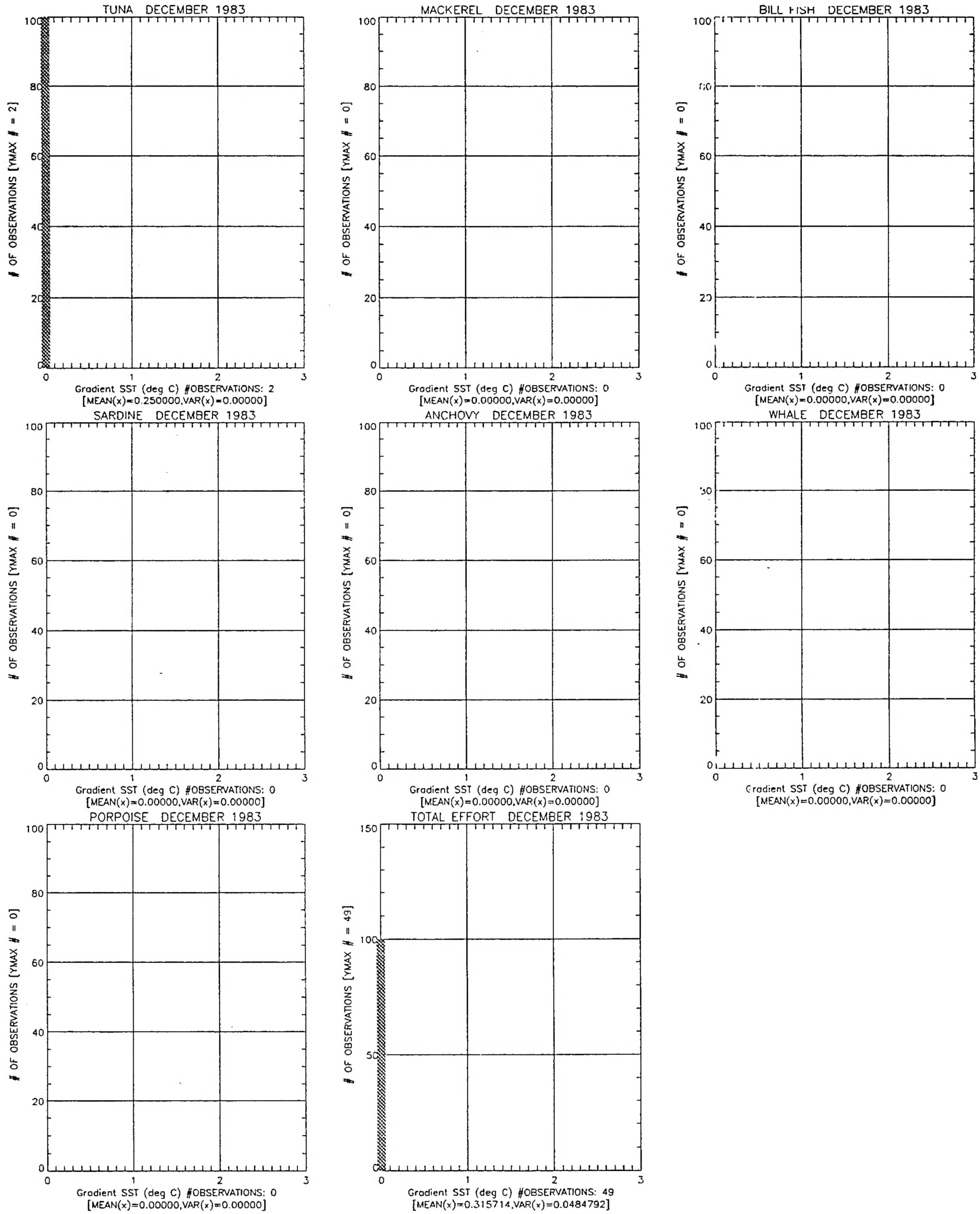

TUNA DECEMBER 1983
OF OBSERVATIONS [YMAX # = 2]
Gradient SST (deg C) #OBSERVATIONS: 2
[MEAN(x)=0.250000,VAR(x)=0.00000]
MACKEREL DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Gradient SST (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT DECEMBER 1983
OF OBSERVATIONS [YMAX # = 49]
Gradient SST (deg C) #OBSERVATIONS: 49
[MEAN(x)=0.315714,VAR(x)=0.0484792]

Figure 96

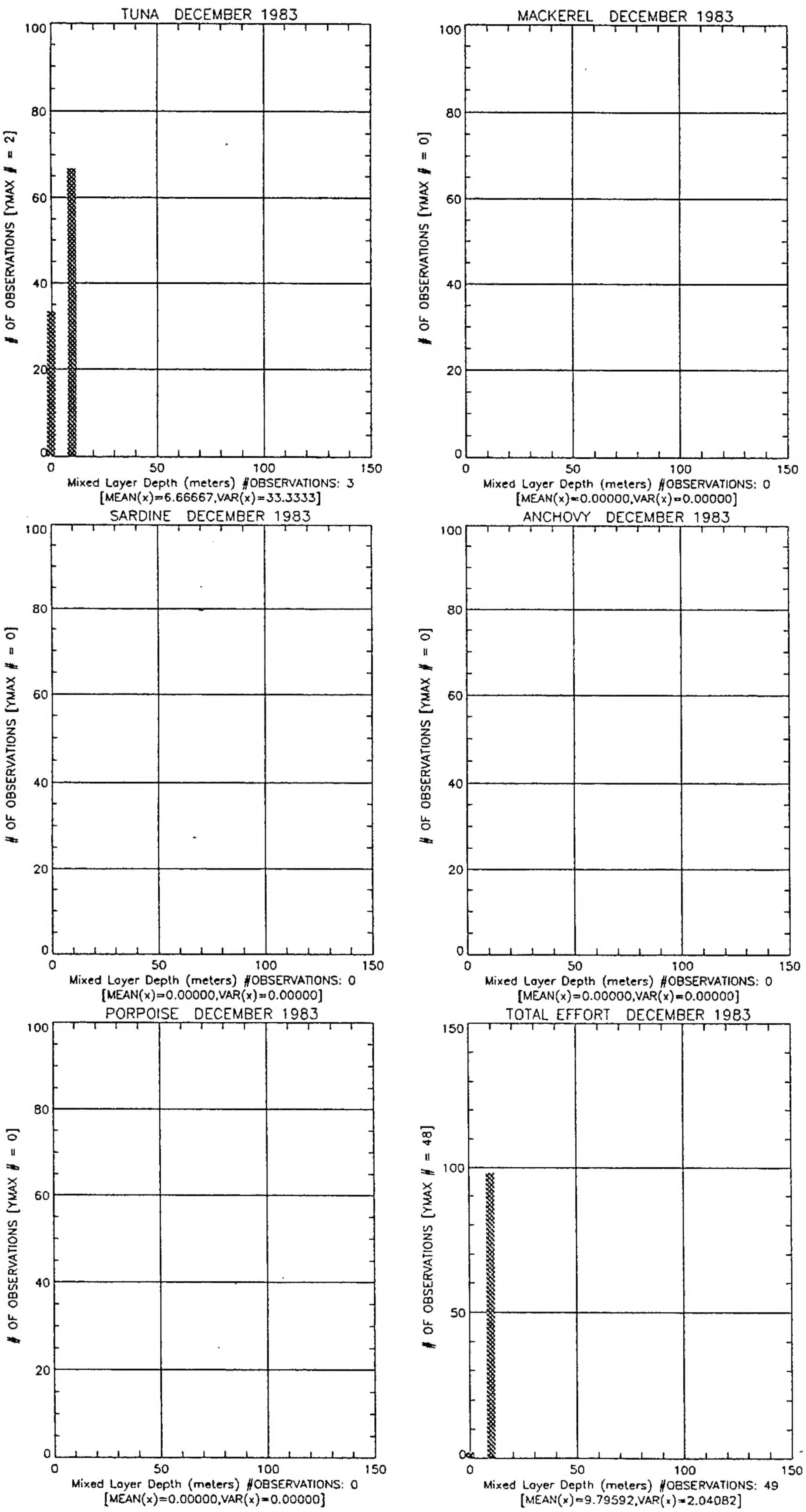
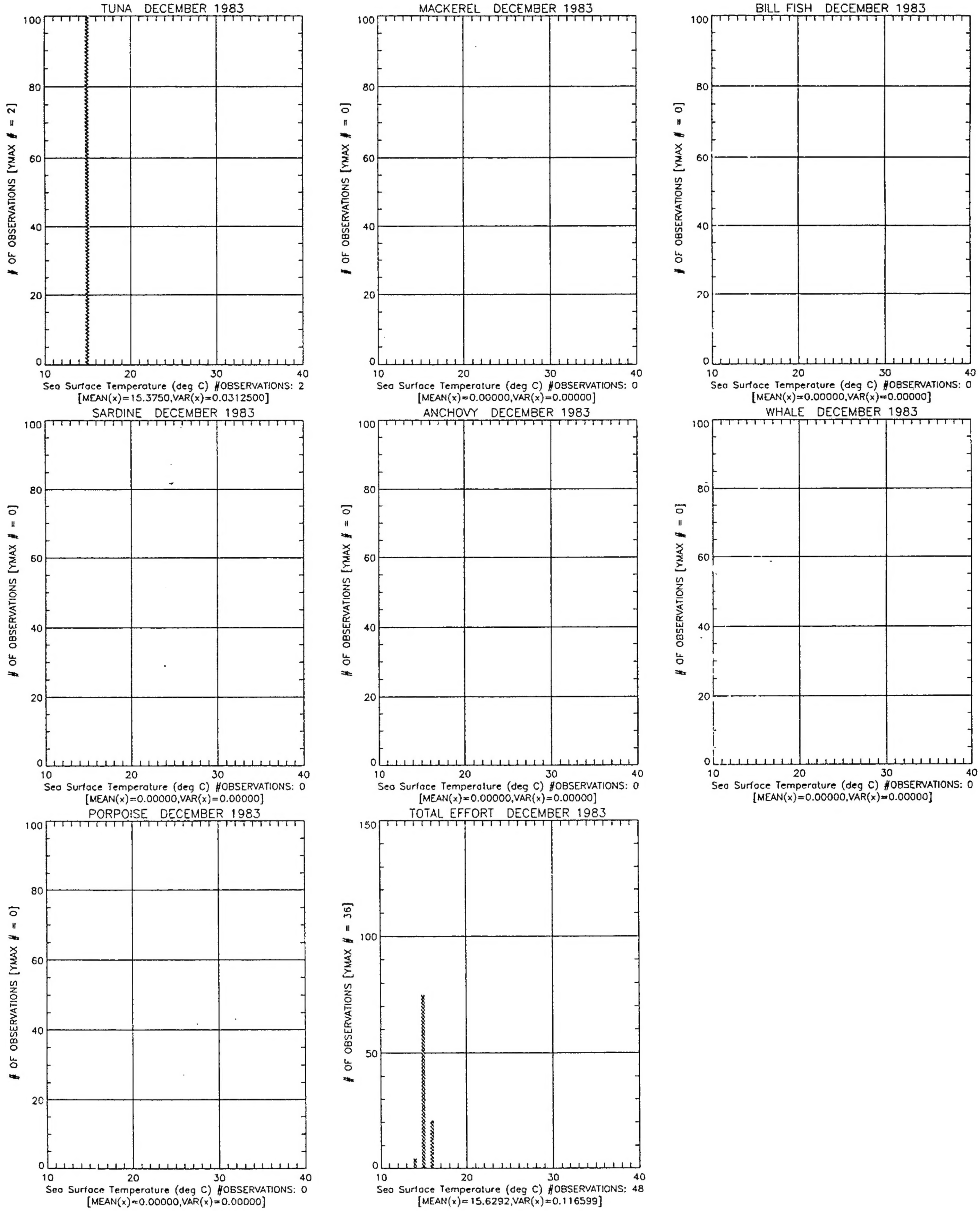

TUNA DECEMBER 1983
OF OBSERVATIONS [YMAX # = 2]
Mixed Layer Depth (meters) #OBSERVATIONS: 3
[MEAN(x)=6.66667,VAR(x)=33.3333]
MACKEREL DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Mixed Layer Depth (meters) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT DECEMBER 1983
OF OBSERVATIONS [YMAX # = 48]
Mixed Layer Depth (meters) #OBSERVATIONS: 49
[MEAN(x)=9.79592,VAR(x)=2.04082]

Figure 97


TUNA DECEMBER 1983
OF OBSERVATIONS [YMAX # = 2]
Sea Surface Temperature (deg C) #OBSERVATIONS: 2
[MEAN(x)=15.3750,VAR(x)=0.0312500]
MACKEREL DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
BILL FISH DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
SARDINE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
ANCHOVY DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
WHALE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
PORPOISE DECEMBER 1983
OF OBSERVATIONS [YMAX # = 0]
Sea Surface Temperature (deg C) #OBSERVATIONS: 0
[MEAN(x)=0.00000,VAR(x)=0.00000]
TOTAL EFFORT DECEMBER 1983
OF OBSERVATIONS [YMAX # = 36]
Sea Surface Temperature (deg C) #OBSERVATIONS: 48
[MEAN(x)=15.6292,VAR(x)=0.116599]